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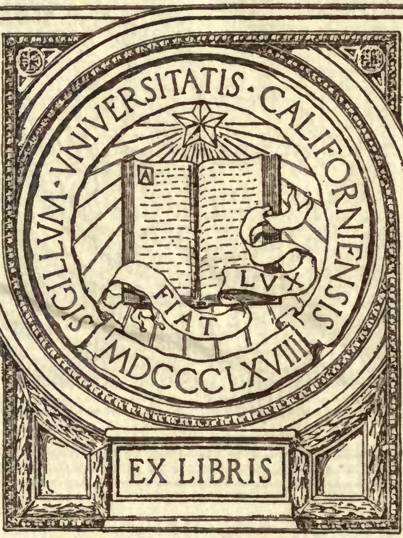

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# MONTANA, IDAHO AND WYOMING FORESTRY PAMPHLETS

## VOL. I

Ornamental Trees and Shrubs for Montana. By R. W. Fisher. Bulletin 80, Montana Agricultural Experiment Station.

Planting Trees and Shrubs on the Dry Farm. By O. B. Whipple. Cir. 14, Montana Agri. Experiment Station. 14 — 2379

Shade Trees and Ornamental Vines in Montana. Montana Experiment Station Annual Report.

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Mushrooms or Toadstools. Bull. 27, Idaho Agri. Experiment Station. L. F. Henderson.

The Trees of Wyoming and How to Know Them. Bull. 40, Wyoming Experiment Station. By Aven Nelson.

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MONTANA AGRICULTURAL COLLEGE
EXPERIMENT STATION

F. B. LINFIELD, Director.

BULLETIN No. 80

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# ORNAMENTAL TREES AND SHRUBS FOR MONTANA

BY
R. W. FISHER.

UNIV. OF
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BOZEMAN, MONTANA.
JULY, 1910.

299103

# MONTANA AGRICULTURAL COLLEGE EXPERIMENT STATION.

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## PREFACE.

This bulletin was outlined by Prof. R. W. Fisher before he severed his connection with the Experiment Station, on July 1, 1909. Some revision was necessary, which Prof. Fisher did not find time to do because of other duties, and Prof. D. B. Swingle, our botanist, and Prof. O. B. Whipple, our horticulturist, finished the revision and prepared the manuscript for publication.

Ornamental tree planting has received but little attention in Montana, particularly by our farmers. While we have much yet to learn, it is hoped that the suggestions contained in this bulletin will increase the interest in the planting of trees and shrubs and the proper caring for them after planting. We believe that the varieties recommended for various altitudes may be relied upon, but would be pleased to receive any information from the personal experiences of the reader, that would supplement the advice here given.

This advice applies more especially to irrigated land. Our studies on tree growing on the dry lands of many parts of the state have not yet progressed far enough to make any report. Our only suggestion now is that for tree planting and tree growth the land should be cultivated exactly the same as for a dry farm grain crop, or more especially a dry farm corn crop.

F. B. LINFIELD,

Director Montana Experiment Station.

# Ornamental Trees and Shrubs for Montana.

## INTRODUCTION

The results of experiments in testing different kinds of ornamental trees and shrubs are given on the following pages, together with some general observations on the success of plants of this character growing in various parts of the state. In selecting the plants for testing, those were chosen that promised well, and had proved their value in other places. We have found that some plants reported as being hardy in places of lower winter temperatures than this station are not hardy here, because of the high altitude of this place, and the resulting short growing season. There are, no doubt, many hardy plants suitable for ornamental purposes which have not yet been tested here. We have chosen those that gave promise of being hardy and adapted to the conditions under which they were to be grown. Much work is yet to be done in gathering plants and testing them for hardiness.

The scientific names of plants used conform to those given in the Cyclopedia of American Horticulture, from which many valuable suggestions have been obtained in regard to the characteristics of ornamental plants.

## THE VALUE OF ORNAMENTAL TREES

No one questions the value of planting ornamental trees and shrubs upon the home grounds. It is conceded by all that trees and shrubs properly placed and planted will add very much to the beauty of any home and thus materially increase its value. Trees and shrubs on the lawn or about houses make living conditions more pleasant and have much to do with the healthfulness of any home.

Success in growing ornamental plants in Montana depends upon the selection of the kinds adapted to our conditions of climate and soil; upon the preparation of the ground; and upon the care in setting out and the subsequent treatment. Special attention to cultivation and irrigation is sometimes necessary in order to properly grow plants and cause them to mature before freezing weather in the fall. Some ornamental plants show a tendency to start growth too early in the spring, and are frequently injured by the late spring frosts. Plants of this kind should be given such treatment that the vegetative growth will be retarded until the liklihood of frost has passed.

## PLANNING THE HOME GROUNDS

The value of ornamental plants about the home depends not alone upon the number of varieties and their adaptability to the soil and climate, but quite as much upon their arrangement with reference to each other and to buildings, roads, fences, etc. Before any planting is done, an accurate working plan should be made of the grounds, showing the position of all buildings, roads, walks, fences, etc., and the place where all the plants are to be set out.

The planting plan should also show the direction of the views from the house and other vantage points, and the trees so placed that these views will not be obstructed. In locating the position of plants, due attention should be given to their size and appearance after they have reached maturity. Mistakes are often made in placing plants too close together. If trees and shrubs are set too close, and not thinned, they are likely to grow tall and slender and much of their natural beauty will be undeveloped. Under certain conditions it is advisable to plant close, with the intention of removing some of the plants as they increase in size. Young plants often need more or less protection; or quick effects may be desired in the landscape, which can be secured by close planting. In any event the plants should be thinned out, as they increase in size and require more room.

There are two general methods of planning landscapes, known as the natural method and the geometrical or artificial method. In the United States the natural method is more generally used and is the better method to follow in making landscapes in Montana. The plants are so arranged that they appear as nature would have placed them. In the artificial method the plants are arranged in geometrical figures, straight lines, or regular curves, and the planting does not conform at all to that found in nature.

Under ordinary conditions the best results will follow when the plants are grouped along the borders of the lawn, in curves or bends of roads and walks, or massed in the background. In selecting plants for groups due attention should be paid to harmony in size and color, otherwise too great contrasts may result. Many otherwise beautiful places are spoiled by having the plants scattered indiscriminately over the lawn, in which case only the beauty of individual plants is seen. If the plants are properly chosen and placed, the whole landscape should form a picture, each plant contributing something to the effect of the whole.

Roads and walks should be located where there is the greatest need for them. When it can be done conveniently they should be built on graceful curves; but if there is no definite reason for having them in curves it is better to lay them out in straight lines. Sometimes it is possible to create an apparent necessity for curved roads or walks by planting groups of trees or shrubs and bending the roads around them. The road should not be wider than is necessary to accommodate the traffic, and footpaths or walks should be located where people will naturally travel and be just wide enough to accommodate those who will use them.

## THE LAWN

The lawn is one of the very essential features in the beautifying of any home ground. The soil for lawns should be plowed deeply, thoroughly manured, and carefully leveled and smoothed before any planting is done. A mixture of thirty pounds of Kentucky blue grass and ten pounds of white clover per acre makes a very desirable lawn in Montana. The seed should be sown as early in the spring as possible and covered to a depth of one-fourth and not over one-half inch. If it is not possible to sow the seed very early in the spring, good results can be obtained by planting later and covering the lawn with straw to a depth of one-half inch, enough to provide a shade and hold moisture until the grass seeds germinate.

Proper facilities for irrigation should be made before the lawn is seeded down. Irrigation of some kind is necessary in Montana in order to keep the grass green throughout the summer months. To maintain a good turf it is necessary to irrigate three or four times during a season and to cut the grass about every ten days or two weeks after the first of June.

## RULES FOR SELECTING ORNAMENTALS

The selection of plants for Montana lawns is a very difficult problem, as many ornamental plants that are valuable in the east, and states farther south, cannot be grown successfully over the whole state. Many of the desirable ornamental plants die in Montana from one or several of the following reasons:

First, **Early fall frosts.** Injury is often due to the fact that the plants do not mature early enough in the fall to stand the first frosts. Many plants are killed before the leaves have fallen in the fall. As a general rule the hardiest plants are those that mature early.

Second, **Low temperature during the winter months.** Comparatively few plants, however, are killed from excessively low temperatures if they matured well in the fall.

Third, **Too much water in the soil.** Plants are sometimes killed during the winter months because of water standing about their trunks or roots. This condition can be avoided by seeing that the soil is well drained and by not applying too much water late in the season.

Fourth, **Plants sometimes become too dry during the winter months and die for want of sufficient moisture.** It is a known fact that plants transpire more or less water during the winter or in the dormant season, and unless the soil has a certain amount of moisture the plants will dry out. In many parts of this state the soil becomes exceedingly dry after the latest fall irrigation. In such cases it is good practice to irrigate after the leaves have fallen and just before the ground freezes. At this irrigation it is necessary to apply only enough water to moisten the ground to a depth at which the roots feed. The ground should not be made too wet.

Fifth, **Sun-scald.** A few ornamental plants are injured during the winter months by so-called sun-scald. This is caused by the sun shining upon the south and west side of the tree trunks during the winter months. The sun will make the south and west sides of the trunk very warm in the daytime and when it freezes hard at night the cells of the bark and the cambium layer are injured, causing them to peel and break away from the trunk. This condition can be prevented by giving shade to the south and west sides of the trunk during the winter months. Shade can be provided by wrapping the trees or shrubs with burlap, heavy paper, or by wooden tree guards.

Sixth, **Late spring frosts.** Some plants have a tendency to start into growth very early in the spring and are frequently injured by spring frosts. Plants that are likely to be injured in this way should be kept dormant as long as possible. Shrubs or trees may be wrapped with burlap, thus providing a shade which will have a tendency to keep them dormant or to retard the growth a week or ten days after the normal time. Many tender and half hardy plants can be grown in Montana by giving slight winter protection, such as wrapping with burlap or some slight covering.

## TREES AND SHRUBS TESTED AT MONTANA EXPERIMENT STATION

### ACANTHOPANAX.

(*Acanthopanax sessiliflorum*) This plant grows into a shrub about twelve feet high. It is a native of Manchuria and northern China. Seeds were sent to us by the U. S. Department of Agriculture and planted in the spring of 1907. Plants have gone through two winters without injury and promise to be hardy at this station. The most decorative feature of this shrub is the cluster of black berries borne the latter part of the season.

### THE MAPLES.

The maples are among the best trees for shade and ornamental purposes. The leaves on many of them assume very bright colors in the fall, adding much to the beauty of fall landscapes. Some are valuable for timber, and some American species produce sugar. For purposes of shade the sugar maple, soft maple and Norway maple are valuable. Maples are propagated by seeds, which are sown in the fall, except in the early maturing kinds and the seeds of these should be planted as soon as they ripen in the spring or summer. Few of the maple seeds retain their vitality long after they ripen and therefore to get good results fresh seed should always be planted.

Silver or Soft Maple: (*Acer saccharinum*) This is a large tree, growing to a height of 120 feet. The leaves are deeply five lobed and from 4 to 6 inches long, green above and silvery white beneath. This tree is a native of eastern North America. It is valuable as a shade and ornamental tree in locations where it can be grown. It grows best upon rich, moist soil. There are many horticultural varieties in this species of which *Weiri* is good. This variety has more deeply cut leaves than others of this species and the branches are more or less drooping.

On the Experiment Station grounds, at an elevation of 4800 feet, the silver maple is not hardy. Trees planted in 1898 were ten feet four inches high in 1902, but the current year's growth killed each year. The wood is brittle and the branches are badly broken by strong winds and unseasonable snow storms. These trees were cut down and destroyed in 1905. In 1903, five hundred trees, from 12 to 18 inches in height, were secured in Iowa and planted. These young trees did not mature in the fall before freezing weather, and killed back each winter. They were plowed out and destroyed in 1906. In 1903, ten trees, from 4 to 6 feet high, were secured in Pennsylvania. The tips killed each winter. The larger trees, however, seemed hardier than the young plants and about one plant out of several hundred seemed entirely hardy. In 1908, one thousand small seedlings were secured in Iowa. In the spring of 1909 all had killed back to the ground.

In the city of Bozeman there are, on some of the older lawns, a few soft maple trees, but they probably represent a very few out of a great many planted. At lower altitudes in the state, where there is a longer growing season, the soft maple is hardy and makes a desirable shade and street tree, although the branches are brittle and are often broken by heavy wind storms. The soft maple is one of the fastest growing trees in this group.

Weir's cut-leaved maple is an improved variety of the soft maple, and seems to be hardier than the others. This tree is distinguished from the original (*Acer saccharinum*) by having deeper lobed leaves and more drooping branches. Its foliage takes on brilliant colors in the fall. Of ten plants, 4 to 6 feet high, secured in Pennsylvania in the spring of 1904 all are still living. The tips of the branches kill back a little each winter, although not enough to interfere seriously with the growth of the trees. At lower altitudes in the state it will make a desirable ornamental tree.

**Manchurian Maple:** (*Acer ginnala*) This is a small tree or shrub, rarely reaching a height of over 20 feet. The leaves are three-lobed and from one and a half to three and a half inches long. It produces a very graceful and ornamental shrub. The leaves take on bright red colors in autumn, which add much to the beauty of the landscape.

Plants grown from seeds secured in Ottawa, Canada, are hardy at this station. Young plants secured in Pennsylvania winter killed to the ground the first year, but new growth came from below the dead portion and they now seem hardy. This is an excellent plant for shrubberies and group plantings and promises to be hardy at this altitude. In lower altitudes in the state it will prove quite hardy.

**Box Elder:** (*Acer Negundo*) This is a tree which reaches a height of about 60 feet; the leaves are pinnate, leaflets three to five in number and from two to five inches long. It is a valuable tree for shelter belts as it will adapt itself to many adverse conditions. It grows best on moist, rich soil. The tree is hardy and adapted to all sections of Montana where water for irrigation is available. It has a spreading shape and is not desirable for street planting.

In 1903, five hundred plants, 6 to 12 inches high, were secured in Iowa and planted in our nursery. These have been hardy and do not winter kill. Trees grown from native gathered seed are also hardy and produce good plants. In 1908, 1,000 small seedlings were secured in Iowa and planted. These killed back one-fourth in the winter of 1908-9, but at this time have started into growth below the injured portion. Old trees growing in Bozeman seem perfectly hard.

Large branches are often broken by heavy winds and unseasonable snow storms. The tree is subject to the attack of several insects which reduces its value for planting on the lawn. The box elder is a good tree for wind breaks and shelter belts, but where other trees can be grown it should not be planted on the lawn or street because of its low spreading habit, the ease with which it is broken by snow or wind and the insects which infest it. The box elder is native to many parts of Montana, particularly along the Missouri and Milk river bottoms.

(*Acer campestre*:) This shrub or tree occasionally attains a height of 50 feet. The leaves are from three to five lobed, from 1½ to 3 inches long, of a dull green color. It is native to Europe and western Asia. Ten plants, 4 to 6 feet high, were secured in Pennsylvania and planted in the spring of 1904. The current year's growth kills back each year. It is not a hardy plant at this station.

**Norway Maple:** (*Acer platanoides*) This is a large tree, often attaining a height of 100 feet. The leaves are five-lobed and from 4 to 7 inches across. It is native to Europe and the Caucasus region. It is a large, beautiful tree, with round, symmetrical head, producing dense shade. It does not grow as rapidly as the soft maple and has a tendency to form branches near the ground which sometimes makes it undesirable as a street tree.

In 1904, five hundred plants, 15 to 24 inches high, were secured in Pennsylvania and planted in our nursery. They were injured somewhat the first winter, but since that time have made a good growth. In 1907, one hundred plants, 18 to 24 inches high, were obtained in North Dakota and planted in our nursery. They were injured badly by freezing the first winter. In 1908, one hundred small plants were secured in Pennsylvania and planted in our nursery. These were killed to the ground in the winter of 1908-9, although new growth is coming out at this time below the injured portion.

The second year after transplanting very little injury usually results. The Norway maple promises to be one of the best trees for general ornamental planting in Montana. While it grows slowly, it is fairly hardy, forms a beautiful symmetrical head, produces good shade, is free from pests and will stand the adverse conditions found in cities fairly well. At lower altitudes than Bozeman, even the young plants of this tree will be entirely hardy.

**Sugar or Rock Maple:** (*Acer saccharum*) This is a large tree growing to a height of 120 feet, with leaves three- to five-lobed and 3 to 6 inches long. The leaves take on a bright scarlet color in the autumn, which produces a very beautiful effect. This is one of the best of the maples for shade and ornamental purposes and is a desirable street tree. It is native to eastern North America. Unfortunately the young trees we have planted have not proved entirely hardy at this station, although at lower altitudes in the state it is growing well and seems to be quite hardy.

In the spring of 1903, two hundred and fity plants, from 12 to 18 inches high, were secured in Iowa. They did not mature in the fall before freezing weather and were injured by the first freeze each fall. Many killed back to the ground. This lot was dug out and destroyed in 1906. In 1904, one hundred trees, 2 to 3 feet high, were obtained from Wisconsin. They killed back to the ground each winter and were destroyed in 1906. Of fifty plants secured in Pennsylvania in 1904, thirteen were alive in the fall of 1908. In the spring of 1909 these had killed back to the ground.

These tests indicate that it is not advisable to attempt to grow the sugar maple for general planting at this altitude, though there are some old trees in the city of Bozeman that are doing well. In portions of the state at lower altitudes, with a longer growing season, the sugar maple can be grown and will be one of the best trees for general ornamental planting.

**Tartarian Maple:** (*Acer Tataricum*) This is a small tree or shrub, rarely attaining a height of over 20 feet. The leaves are roundish, oval or oblong, sometimes slightly lobed, 2 to 4 inches long. It is a native of southeastern Europe and the Orient. It forms a round headed small tree or shrub and grows best in moist fertile soils.

In 1898 plants were secured from the U. S. Department of Agriculture and set in our nursery. These have been hardy and are growing at this time. In 1904 seeds were secured from them and planted and the young seedlings have been hardy. The Tartarian maple is desirable for groups and shrubberies and will prove a valuable addition to our list of hardy shrubs. It can be grown in any part of Montana where the soil is fertile and irrigation water can be supplied.

## THE SERVICE OR JUNE BERRIES

There are several species of the service berry that are desirable shrubs for ornamental planting. The leaves are alternate and simple; the flowers are white and borne in racemes. It produces a round berry which is dark purple or red and is used for jellies and jams. Plants are propagated by seeds or by suckers. If grown from seeds, these should be gathered in the fall and stratified, and planted early the following spring in moist, fertile soil.

**Western Service Berry:** (*Amelanchier alnifolia*) Seeds of this plant were secured in Bridger canyon near Bozeman in the fall of 1904 and planted in the seed bed in the spring of 1905. In the fall of 1906 they were from 6 to 12 inches high. It is hardy and desirable for shrubberies and group plantings. The white flowers are produced early in the spring, and the dark purple berries in the late summer or fall add much to the beauty of shrubberies.

**Common Dwarf June Berry:** (*Amelanchier Botryapium*) This is a bush or small tree, rarely attaining a height of over 15 feet. The leaves are more or less oblong and broadly elliptical. This plant is native to New Brunswick, Florida and western Minnesota. Two plants were secured in Iowa in 1904, and set in our nursery. Both have grown and seem perfectly hardy.

### AILANTHUS.

**Tree of Heaven:** (*Ailanthus glandulosa*) Only this species of the genus has been tested at this station. It makes a tree 60 feet high; the leaves are from 1½ to 2 feet long, with from 15 to 25 leaflets. It is a native of China. In 1904 and again in 1905 seeds of *Ailanthus glandulosa* were planted in a seed bed, but each year the plants killed back to the ground and did not grow the following spring. It is not hardy enough for this climate.

### THE WOODBINES.

These are climbing vines with alternate leaves, and are closely allied to the grape. They are easily propagated by seeds and by hard or green wood cuttings, and they make a rapid growth.

**Virginia Creeper:** (*Ampelopsis quinquefolia*) This is a hardy vine at this station. Fifty plants, two years old, were set out in 1904. The first winter the tips killed back; the second winter the plants were covered and they were not injured. In 1907 they were transplanted to the college campus where they are now making a vigorous growth.

**Engleman Ivy:** (*Ampelopsis Engelmanni*) This is apparently as hardy as *A. quinquefolia*. The essential difference between the two is the smaller sized leaves in the Engleman ivy and a more dense foliage. What is still more important, the Engelman ivy clings to brick or stone walls without support, while the Virginia creeper requires a wire trellis. The common Virginia creeper is a very desirable vine to provide shade over porch screens, especially in locations where some slight protection against the winter sun can be afforded, while the Engelman ivy is excellent to cover the walls of buildings.

## ARALIA

**Chinese Angelica Tree :** (*Aralia Chinensis var. Mandshurica*) Specimens of this shrub were sent us from the U. S. Department of Agriculture, and planted in the spring of 1907, since which time they have been entirely hardy. It is an ornamental tree, which grows 40 feet high, with large leaves and flower clusters.

## ARTEMISIA.

This genus includes a large number of herbs and small shrubs. To it belongs our common sage brush.

**Southernwood:** (*Artemisia Abrotanum*) This is the only species of the genus that has been tested at this station. It is a small shrub 3 to 5 feet high; native of Europe. It is not hardy at this station and was destroyed soon after planting.

## BERBERIS.

This genus includes a large number of shrubs, the inner bark and wood of which is yellow. Flowers are usually borne in racemes. Most of the species are deciduous, only a few being evergreen. Most of the deciduous species are hardy and can be grown in the northern states. Some of the evergreen species are hardy in the north when given slight winter protection.

**Common Green Barberry :** (*Berberis vulgaris*) In the spring of 1904 one hundred plants, 1 to 1½ feet high were secured in Pennsylvania and set out in the experimental nursery. The first fall the leaves did not mature until after freezing weather. The plants were only slightly injured and since that time have not winter killed at all. This is a handsome shrub in the spring, with its yellow flowers and light green foliage. In the fall and winter it attracts attention because of the bright red berries, which it carries during most of the winter months. It is valuable for shrubberies and hedges.

**Purple Barberry :** (*Berberis vulgaris var. atropurpurea*) This is similar to the green barberry, except that the leaves are purple in color. The purple leaved barberry is hardy at this station and is valuable for shrubbery or hedge planting.

**Dwarf Barberry :** (*Berberis Thunbergii*) This is a low shrub from 2 to 4 feet high, the flowers are pale yellow, the berries or fruit are bright red. It is valuable for border planting along walks and drives. In 1898, plants of *Berberis Thunbergii* were set in the experimental nursery. The terminal growths sometimes kill back, but not enough to seriously injure its vigor. In the spring of 1904 seeds of *Berberis Thunbergii* were planted in seed beds and later the seedlings were transplanted to the experimental nursery. In the winter of 1908-9 they killed back about one-third. Old plants grown on the college campus were not injured at that time, indicating that they will endure colder weather than will young plants.

**Holly Barberry :** (*Berberis Aquifolium*) This is the only evergreen barberry that has been tested at this station. In the spring of 1903 ten plants were obtained from Pennsylvania and planted in the nursery. When given shade or slight protection during the winter they were hardy, but they are not hardy when grown in an exposed place.

**Oregon Grape :** (*Berberis repens*) This is a native evergreen barberry and is valuable to grow in shady and protected places.

### THE BIRCHES.

The birch genus, *Betula,* includes a number of trees and shrubs. The leaves are alternate and deciduous, the flowers are monoecious, apetalous in catkins and open in the spring with the leaves. The staminate catkins, usually long and pendulous, are formed in the fall and remain on the trees naked during the winter. Trees in this genus are found as far north as any trees that grow.

The birches are very ornamental trees and are found in parks and lawns throughout all the northern states and in Canada. They are propagated from seeds which should be sown in sandy soil soon after they mature. Some of the rare species are propagated by grafting or budding while some of the shrub forms are propagated by layers.

**European White Birch :** (*Betula alba*) This tree sometimes reaches a height of 80 feet. The bark on the trunk and larger branches is white; the leaves are slender and ovate, with an acute point. It is a native of Europe. In 1898 several European white birch trees were planted in the experiment station nursery. In 1902 they had reached a height of 17 feet and were at that time transplanted to the college campus, and at this time they are hardy and making a vigorous growth each year. This is a hardy tree and excellent for ornamental planting where only partial shade is desired. It does not, however, make a tree large enough for street planting.

**Cut-Leaved Weeping Birch:** (*Betula alba var. pendula laciniata*) This variety differs from the European white birch in having whiter bark and beautiful long drooping branches. It is one of our most graceful trees and has probably contributed more than any other to the beauty of the lawns in Montana towns and cities. It is entirely hardy and grows fairly rapidly and is highly ornamental at any season of the year. It is not intended for a street tree, however, on account of its limited size and pendulous branches.

**Yellow Birch:** (*Betula lutea*) This tree sometimes grows to 100 feet in height. The bark is light yellow in young trees. On old trunks it becomes reddish brown. It is native in Newfoundland and south to the Carolinas and Tennessee and west as far as Minnesota.

In the spring of 1908, one hundred small plants were set out in the experimental nursery. These killed back about one- third during the winter of 1908-9. When they become acclimated they promise to be entirely hardy and will be a valuable addition to the list of ornamental plants.

**American White Birch:** (*Betula populifolia*) This is a small tree rarely growing higher than 40 feet. It has smooth white bark. The leaves are slender and triangular. It is native from New Brunswick to Delaware and west to Ontario and Montana. It has been grown in the experimental nursery for five years and is perfectly hardy, except that young plants occasionally suffer a little winter injury the first season after transplanting.

### THE PEA TREE OR CARAGANA

This genus includes several shrubs and small trees. The leaves are deciduous and pinnate; the leaflets are small and entire; flowers pea-like in form, usually yellow.

**Siberian Pea Tree:** (*Caragana arborescens*) In 1904, twenty-five plants 2 to 3 feet high were secured in Pennsylvania and planted in the experimental nursery. They have been entirely hardy and in 1907 were transplanted to the college campus. This will produce a shrub or small tree sometimes 20 feet in height. Because of its hardiness, it is valuable for shrubberies or group planting. The flowers are pea-like in form, yellow in color and are produced in late spring or early summer. The bark of the young plant is bright green. It is readily propagated from seeds sown in the spring. It is native in Russia and Manchuria.

(*Caragana frutescens*) In 1898 plants were secured from the U. S. Department of Agriculture and set out in the experimental nursery. They have been entirely hardy and are now growing on the college campus. This is a shrub which grows 6 to 10 feet high; the flowers are yellow in color, produced singly, from ¾ to 1 inch long. They are borne in May or June. It is a native of southern Russia and China.

## CATALPA.

This genus includes several deciduous trees, with opposite long petioled, large and simple leaves. They are highly ornamental, with a large bright green leaf and showy flowers. The soft coarse-grained wood is very durable, when set in the soil, which makes it valuable for fence posts. Some of the species make a rapid growth and are much planted in certain sections of the United States for economic uses.

**Western Catalpa:** (*Catalpa speciosa*) In 1903 five hundred plants were set in the experimental nursery at this station. For three years they died to the ground each winter and in the spring of 1906 they were plowed out and destroyed. The growing season is too short at this altitude for the wood to mature, the plants usually being killed back by the first hard freeze in the fall.

## CELASTRUS

This genus includes several shrubs, most of which are climbers. Only one species has been tested at this station.

**False Bitter Sweet:** (*Celastrus scandens*) This is a climbing vine, often reaching 20 feet in height. It is native from Canada through the western Mississippi valley to New Mexico. In 1904 plants 12 to 18 inches high, were secured in Pennsylvania and planted in the experimental nursery. They killed to the ground each winter and were destroyed in the spring of 1908, not proving hardy at this altitude.

### CELTIS

This genus includes several trees and shrubs which are valuable for shade or as specimens on lawns. They are characterized by a wide spreading head and light green foliage. Plants are propagated by seeds sown soon after they ripen. One species has been tested at this station.

**Hackberry:** (*Celtis occidentalis*) In 1904 ten plants 4 to 6 feet high were set in the experimental nursery. They killed back each winter and were destroyed in the spring of 1907.

### CERCIS.

This genus includes several trees and shrubs. The leaves are deciduous, entire and alternate. The flowers are pea-like in form, and appear before or with the leaves. They are very ornamental and are well adapted for group planting or as specimens on the lawn. They are propagated by seeds in the spring.

**Red Bud.** (*Cercis Canadensis*) This species produces a tree about 40 feet in height. In 1904 six plants were secured in Iowa and set in the experimental nursery. In the fall of 1904 they were badly injured by a hard freeze the last of November. In the spring of 1905 they were all dead. At this altitude *Cercis* is not hardy enough for general planting.

### CHIONANTHUS.

**White Fringe or Fringe Tree:** (*Chionanthus Virginica*) In 1903 ten plants of White Fringe were secured in Pennsylvania. These grew through the first summer without injury. In the spring of 1905 their tops were killed back and during each of the following winters this was repeated. In the spring of 1907 they were destroyed.

### CLADRASTIS.

**Yellowwood:** (*Cladrastis amurensis*) This grows into a tree about 40 feet in height and is native to Manchuria. Seeds were sown in the spring of 1907 and since that time the young plants have been entirely hardy. It promises to be hardy enough for general planting in Montana.

### VIRGIN'S-BOWER

With this are included a number of climbing vines and perennial herbs. Many of them are valuable to screen porches and to use in covering fences or unsightly objects. The following species are hardy at this station: *Clematis Flammula, C. Drummondi, C. paniculata, C. Virginiana.*

(*Clematis verticillaris var. Columbiana*) is native to Montana, and in locations where it can be given slight winter protection it will prove hardy under cultivation.

**Common Wild Clematis** (*Clematis lingusticifolia*) This vine is native to many parts of Montana and is entirely hardy even at relatively high altitudes. It makes a very rapid growth and bears white flowers during the summer and feathery seeds in the fall. Its rapid growth and climbing habit make some care necessary in its training, but it is on the whole an excellent vine for porch screens and similar purposes.

## DOGWOOD.

The dogwood genus, *Cornus,* includes some desirable ornamental trees and shrubs. They are chiefly valued in shrubbery because of the green foliage during the summer, and bright red color of the twigs and branches during the winter months. The leaves are opposite, deciduous and entire; the flowers on most species are small and inconspicuous. There are several species native to Montana that are valuable for ornamental purposes and are hardy under cultivation.

(*Cornus alba var. Sibirica*) In 1898 plants were obtained from the U. S. Department of Agriculture. The branches have a bright red color and add much to the variety of winter landscapes. These plants have proved entirely hardy at this station. They are desirable to place in shrubberies. The species is native to Siberia and northern China.

## COTONEASTER.

This genus is closely related to the apple. It is a shrub with alternate dciduous leaves.

(*Cotoneaster acutifolia*) This species has been tested at this station and is not hardy.

## THE HAWTHORNS

These are shrubs or small trees. They are usually thorny with alternate and deciduous leaves. The flowers are showy and very similar to those of the apple and pear. Some of the species in this genus are valuable shrubs for group planting and a few make desirable hedge plants. The white or red flowers in the spring produce beautiful effects and the bright green foliage during summer months and the black or red berries in the fall add much to the landscape.

**Scarlet Thorn:** (*Crataegus coccinea*) In 1904, fifty plants 24 to 30 inches in height were secured in Pennsylvania and planted in the experimental nursery. They have proved hardy and in 1907 were transplanted to the college campus. It is a shrub growing to a height of 15 or 20 feet, with bright green foliage during the summer and red berries in the fall, which frequently stay on until late in the winter. It is entirely hardy and will make a vigorous growth on rich moist land.

**Cockspur Thorn:** (*Crataegus Crus-galli*) This is a shrub or tree sometimes growing to a height of 40 feet. The branches have numerous slender spines. The fruit is more or less round, and red. This plant is native from Quebec south to Florida and Texas. It is a very decorative species. In November 1904, the plants were badly injured by a frost as they were late in maturing, and in the spring of 1905 most of them had died. By May 1907 they were all dead.

**Black Haw** (*Crataegus Douglasi*) This is native to Montana and is similar in size and characteristics to the Scarlet Thorn except that the fruit is black.

### DEUTZIA

This genus includes a number of very ornamental shrubs, but unfortunately none of them have so far proved hardy at this station.

(*Deutzia parviflora*) This is a shrub growing to a height of 6 feet. In 1898 a single plant was secured from the U. S. Department of Agriculture. It is not hardy and was dead in the spring of 1902.

(*Deutzia scabra*) In 1903 ten plants were secured in Pennsylvania. They were badly injured the first winter, and in the spring of 1904 the tops had died back to near the ground. New growth came from below the surface of the ground, but this was again injured in the fall and winter of 1905. In the spring of 1907 they were so badly injured that all were destroyed.

(*Deutzia Lemoinei*) In 1903 ten plants of this species were set in the experimental nursery, but by the spring of 1905 all had died except two and they had killed back to near the ground. This species is too tender for this altitude and not at all desirable for general planting, although it seemed to be the hardiest of any species of this genus tested.

### WEIGELA

This includes a number of ornamental shrubs which have not proved hardy at this station.

(*Diervilla Middendorffiana*) This is an ornamental shrub growing to a height of three feet and is a native of eastern Siberia and northern China. It was planted in the experimental nursery in 1898 but proved tender and had died before 1902.

### DIOSPYROS.

**Persimmon :** (*Diospyros Virginiana*) Several of these plants were sent us for experimental purposes from Iowa, but they were tender and killed the first winter.

### ELAEAGNUS

**Oleaster or Russian Olive :** (*Elaeagnus angustifolia*) This is a shrub or small tree rarely growing to a height of more than 20 feet. The stems are usually spiny, the leaves lanceolate and light green above and silvery white below. Plants of this species were secured in South Dakota in the spring of 1906 and since that time have been entirely hardy at this station. In outward appearance it bears a close resemblance to the native Buffalo berry. It is more desirable, however, for ornamental purposes, and promises to be entirely hardy for general planting in Montana and will be valuable for groups of shrubbery or for ornamental or protective hedges.

### EUONYMUS

This group includes a number of deciduous and evergreen shrubs which are valuable for group planting. A few species are desirable as specimens on the lawn.

**Spindel Tree, Burning Bush :** (*Euonymus atropurpureus*) Fifty plants, 12 to 18 inches high, were secured in Pennsylvania in 1904. They have proved hardy enough for general planting. Sometimes the tips of the current year's growth are slightly injured by frosts but not enough to interfere with normal growth. It is a deciduous species and a fairly good plant for ornamental purposes in Montana.

## THE BEECHES.

These are mostly tall, deciduous trees, which grow both wild and under cultivation in the eastern United States and several European countries. They are among the most ornamental and beautiful trees for park planting.

**European Beech :** (*Fagus sylvatica*) This tree has been tested at this station and proved to be not hardy, the plants killing back every winter.

## THE ASHES.

These are ornamental deciduous trees, with opposite leaves large and pinnate. The flowers are small and inconspicuous. Several of the trees in this group are valuable for street and parking purposes. They are propagated by seeds, which should be sown in the fall soon after they mature, or stratified and sown in the spring. Sometimes they will remain dormant in the soil until the second year. Two species have been tested at this station.

**White Ash :** (*Fraxinus Americana*) In 1902 a number of white ash trees were growing in the experimental station nursery. They were at that time 9 feet, 6 inches high. In the spring of 1904 they were transplanted to the college campus and since then have been hardy and have made a vigorous growth. In 1903 a number of plants 12 to 18 inches high were secured in Iowa and set out in the experimental nursery. These small plants killed back each year. In the spring of 1906 they were so badly injured that they were plowed out. The trees, when 5 to 8 feet high, if not cultivated late in the season, appear to be hardy at this altitude and may be recommended for planting. At lower altitudes in the state the white ash promises to be entirely hardy at all stages of growth and should afford a good tree for street and park planting.

**Green Ash :** (*Fraxinus lanceolata*) In the spring of 1904 five hundred plants, 5 to 6 inches high, were secured in Iowa and planted in the experimental nursery. In the spring of 1905 all their tops were badly injured, some being killed back to the ground. In the spring of 1907 the whole lot was so badly injured that it was plowed out. The green ash is native to the eastern part of Montana, along the Yellowstone and lower Milk river valleys. There it grows from 20 to 50 feet high, and when brought under cultivation will make a desirable ornamental tree. These native trees have not been tested at the experiment station, but we would expect them to be exceptionally hardy.

### GLEDITSCHIA.

This genus contains several species of ornamental deciduous trees. It belongs to the order Leguminosae, and has the characteristics of that order with pinnate leaves and pea-like flowers, the seeds being produced in pods.

**Honey or Sweet Locust:** (*Gleditschia triacanthos*) This species has been tested at this station. It grows to a height of 50 to 140 feet and is covered with spines from 2 to 4 inches long. The leaves are 6 to 8 inches long, pinnate, with 20 to 30 leaflets. The pods are 12 to 18 inches long and red brown in color. It is a native of Pennsylvania and thence south to Mississippi and west to Nebraska and Texas. At this station it is not hardy, the current year's growth killing back each winter. At lower altitudes in the state it is hardy and makes a good ornamental tree.

### HIPPOPHEA.

**Sea Buckthorn:** (*Hippophae rhamnoides*) Plants of this species were secured in 1906 from the South Dakota Experiment Station and planted in the experimental nursery. They are entirely hardy at this station and promise to be a valuable addition to our list of ornamental plants. There seem to be two distinct forms of this species. Hansen, in Bulletin No. 72 of the South Dakota Experiment Station, says: "The French form of this species winter killed at Fort Petersburg, Russia, while the form from Irutsk, on Lake Baikel, Siberia, proved hardy." The plants secured for this station are of Siberian origin, and are given the name of Siberian Sand Thorn by Prof. Hansen. The leaves are grayish green above and silvery green below, which gives a very distinct effect in shrubbery groups. It is valuable for shrubbery or group planting and will also make a very desirable hedge. It is propagated by seeds sown in the spring.

### JUGLANS

**Black Walnut:** (*Juglans nigra*) This tree grows to a height of 150 feet and promises to be one of the very desirable street and ornamental trees. In the experimental nursery it has not been entirely hardy, the foliage being killed by the first frost in the fall, which often injured the buds. In years when the foliage is not injured before the wood matures, the trees go through the winter without harm. At lower altitudes in the state it is perfectly hardy and is one of the very good ornamental trees. It grows to a large size, has a spreading head, and affords excellent shade.

### LABURNUM

**Scotch Laburnum:** (*Laburnum alpinum*) This plant belongs to the order Leguminosae and grows to a height of 25 to 30 feet. The flowers are pea-like in form and the seeds are produced in pods. At this station it is not entirely hardy, the current year's growth killing back every winter one-half or more.

### PRIVET

The genus to which this plant belongs includes several ornamental shrubs or small trees, with deciduous or evergreen leaves. They are valuable for shrubberies and group planting and some of the species are used in hedges. They are propagated by seeds, which are either sown in the fall or stratified and sown the following spring. They are also increased by cuttings of mature wood.

**California Privet:** (*Ligustrum ovalifolium*) In 1898 plants of this species were set out on the college campus. They are half evergreen plants and are not well adapted to this altitude, the terminal growths frequently killing back one-half or more. At lower altitudes in the state, where there is a longer growing season, they will no doubt prove hardy and be adapted for general culture.

(*Ligustrum Amurense*) Plants of this species were set out in the experimental nursery in 1907. They killed back each winter and are not hardy enough for general planting.

(*Ligustrum ovalifolium var. aureo-marginatum*) This is hardy here if given slight winter protection. The leaves are edged with yellow and are evergreen.

(*Ligustrum Ibota*) This was planted in the experimental nursery in 1905, but died the first winter.

### THE HONEYSUCKLES

These are ornamental deciduous shrubs of upright or climbing habit. The leaves are opposite and entire; the flowers are small, pea-like in form and have a variety of colors, including white, yellow, pink, scarlet and purple; many of them being very fragrant. Some of the species are valuable for shrubberies and group planting, while others make desirable climbing vines.

(*Lonicera spinosa*) This is a shrub about two feet high, with fragrant, rose-pink flowers. It is native to Turkestan and the Himalayas. Plants of this species set in the experimental nursery in 1904 have proved hardy. It is desirable for shrubberies or for specimen plants on the lawn.

(*Lonicera punicea*) This species is not hardy at this station, the growth killing back every winter.

**Tartarian Honseysuckle:** (*Lonicera Tatarica*) This shrub grows to a height of 10 feet and has slender flowers of pink, crimson or white color. It is a native of Russia and Siberia, has proved hardy at this station, and is desirable for shrubbery or group planting.

### THE MULBERRY

**Russian Mulberry:** (*Morus alba var. Tatarica*) At this station this variety is not hardy, the growth killing back to near the ground every year. The foliage freezes on the plant each fall, indicating that the season is not long enough for it to mature properly. In sections of the state with longer growing season it may be hardy.

### MOCK ORANGE OR SYRINGA.

There are included here a large number of ornamental deciduous shrubs. They have opposite entire leaves and white showy flowers, which are borne in racemes, or short panicles, and are often very fragrant. These plants are all adapted to shrubberies and a few are desirable as specimen plants on the lawn.

(*Philadelphus coronarius, var. aureus*) This shrub grows to a height of 10 feet. The flowers are white and very fragrant and are borne in racemes. The foliage is yellow, giving it a distinct color in the shrubbery group; but it is not hardy at this station, the growth killing back about one-half each winter.

**Common Mock Orange:** (*Philadelphus coronarius*) This plant is the same as the foregoing except the leaves, which are green in color. It is about half hardy at this station. When given some winter protection it survives and becomes a very desirable plant for shrubberies.

**Large Flowering Mock Orange:** (*Philadelphus inodorus*) In 1904 plants 1 to 2 feet high were secured in Pennsylvania and set out in the experimental nursery. Since that time they have proved to be almost hardy and are a valuable addition to ornamental plants at this station. Given slight winter protection it is hardy. The terminal growths frequently kill back in the winters but not enough to seriously interfere with the development of the plant.

(*Philadelphus Lemoinei*) This plant is a hybrid between *P. microphyllus* and *P. coronarius.* In 1904 plants one foot in height were secured in Pennsylvania and set out in the experimental nursery. Since that time they have proved to be almost hardy when given slight winter protection. In exposed places terminal growths kill back but rarely enough to seriously interfere with subsequent growth. This is a very desirable plant for the shrubbery group.

## PHILODENDRON.

(*Philodendron Amurensis*) Seeds of this plant were sent from the U. S. Department of Agriculture and planted in the spring of 1907. The young tips were winter killed in the spring of 1908-9. It does not promise to be entirely hardy at this station.

## THE POPLARS.

These are all soft wooded trees. Poplars, as a class, are very fast growing, usually producing trees not above medium size. They are easily propagated, growing readily from hard wood cuttings. They thrive in a great variety of soils and do best when grown on land that is rather moist. They are valuable for shelter belts and wind breaks, and are used in certain sections for street and shade trees. Poplars are dioecious, that is, the staminate and pistillate flowers are borne on separate plants. The pistillate plants are the ones that produce the so-called cotton, which is so undesirable in the spring when the seeds are ripe. When propagated by cuttings from the staminate trees only, the cotton does not appear. Several kinds have been tried at this station.

**Narrow-Leaved Cottonwood:** (*Populus angustifolia*) This tree is native to many parts of Montana and grows to a height of about 50 feet. It is not a desirable tree for street or ornamental purposes, especially the cottony pistillate form.

**Balsam Poplar:** (*Populus balsamifera, var. latifolia*) This tree is very hardy at this station and promises to be desirable for street and planting purposes. The wood matures early in the fall and the leaves drop before freezing weather. It has not been injured by freezing at any time since it was planted in 1902, and may be regarded as one of the best poplars.

**Balsam or Canadian Poplar:** (*Populus balsamifera*) This tree is very hardy at this station and promises to be desirable for street planting purposes. The wood matures early in the fall and the leaves drop before freezing weather. It has not been injured by freezing at any time since it was planted in 1902, and may be regarded as one of the best poplars.

**Bolles Poplar:** (*Populus alba, var. Bolleana*) This is a tall tree with silvery white leaves, which are more or less deeply lobed. It produces a pleasing effect when planted on a lawn, and promises to be a good tree for general use in Montana. Trees of this species were planted in 1904 and have been entirely hardy since that time.

**Carolina Poplar:** (*Populus deltoides, var. Carolinensis*) This is a very common tree in Montana, being planted for street and ornamental purposes in almost every city in the state. It grows into a well shaped tree and affords good shade. It is short lived, however, and does not promise to be a permanent tree. From those planted at this station, we are led to believe it will not be hardy at this altitude. Young trees are hardy until they become five or six years old, when the branches start to die. At lower altitudes in the state the tree seems hardy and is a desirable one to plant for quick results.

**Certinensis Poplar:** (*Populus laurifolia*) This is a very rapid growing and hardy tree. It is somewhat similar to the Carolina poplar in the form of the top. At this station *Populus laurifolia* has given the best results of any tree in the group and promises to be good for street and ornamental purposes.

## PLUM AND CHERRY.

There are here included a large number of ornamental as well as the domestic plums, prunes, cherries, apricots, almonds, etc.

Several ornamental kinds have been tested at this station.

**Russian Almond:** (*Prunus Nana*) Plants of this species were set out in 1898 and proved to be not hardy at this station.

**Purple-Leaved Plum:** (*Prunus pissardi*) Five plants of this species were set out in 1903. Since that time they have killed back in winter but very little, and promise to be hardy enough for general planting. Because of the purple colored foliage they produce a pleasing effect upon the lawn.

**Common Wild Bird or Pin Cherry:** (*Prunus Pennsylvanica*) This is native from Newfoundland and British Columbia, south and west to Colorado. The terminal growth kills back each winter and it does not promise to be hardy for general planting at this altitude. In lower altitudes of the state it will be hardy and a desirable ornamental plant.

**Flowering Plum:** (*Prunus triloba*) Plants of this species were secured in Iowa in 1903 and since that time have been more or less hardy here. The terminal growths sometimes kill back but not enough to interfere with subsequent development. At lower altitudes in the state it will prove hardy and make a very ornamental plant.

**Sand Cherry:** (*Prunus pumila*) This grows into a shrub 5 to 8 feet in height. It is found growing native in several of our northern states and in southwestern Canada. Seeds were planted in the spring of 1907 and the young plants killed back during the winter of 1908-9. It does not promise to be entirely hardy at this station.

**Choke Cherry:** (*Prunus Virginiana*) This shrub is native in most parts of Montana and is easily transplanted to the lawn, where it makes a very desirable ornamental plant. It may be propagated by stratifying the seeds and planting them in the spring. It is entirely hardy at this station and is one of the very good plants for the shrubbery.

## THE APPLE.

**Siberian Crab:** ((*Pyrus baccata*) This is a small spreading tree or shrub, with symmetrical head and smooth slender stems. The flowers appear with the leaves in May or early June, are borne in clusters and are pure white. The fruit is from three-fourths to one inch in diameter and is red or yellow. This plant is a native of

Siberia and Manchuria. It is hardy at this station and is one of the very good plants for the shrubbery or as a specimen upon the lawn. It is propagated from seeds, which should be gathered in the fall and stratified and planted in the nursery row in the spring.

## THE OAKS

The oaks comprise some of the most ornamental deciduous trees grown in the United States. They are usually propagated by seeds, sown soon after they are ripe in the fall.

**Scarlet Oak:** (*Quercus coccinea*) In 1904 plants 4 to 6 feet high were secured in Pennsylvania and set out in the nursery. In the spring of 1908 they had all winter killed. In the spring of 1907 plants were sent us from the U. S. Department of Agriculture. In 1909 all of these plants had winter killed. It is not hardy enough for general planting at this altiutde.

**Burr Oak:** (*Quercus macrocarpa*) This tree is native in parts of Montana, where it is known as the scrub oak. It grows into a tree not exceeding 40 feet in height. It is hardy at this station but very slow growing and not desirable as a street or shade tree because of its small size and slowness of growth.

**White Oak:** (*Quercus alba*) The white oak is one of the very desirable trees for street planting, and at lower altitudes in Montana will no doubt be sufficiently hardy. At this station the white oak has not been hardy. Trees from 4 to 6 feet high were set out in 1904. In the spring of 1908 all had winter killed.

**Pin Oak:** (*Quercus palustris*) The pin oak is often used for street purposes. It is one of the fast growing oaks and does best when planted on moist rich soil. Plants 4 to 6 feet high, set out in 1904, had all winter killed by the spring of 1908.

(*Quercus pedunculata*) This is not hardy at this station. Trees planted in 1904 had winter killed by the spring of 1905.

**Red Oak:** (*Quercus rubra*) This is not hardy at this station and trees set in 1903 had all winter killed by the spring of 1905.

At this altitude the burr oak is the only tree in the genus that has been found entirely hardy, although at lower altitudes the pin oak and white oak promise to do well and are desirable trees for street and ornamental purposes.

## RHAMNUS.

**Buckthorn:.** (*Rhamnus cathartica*) This is a shrub growing to a height of 10 or 12 feet, usually with thorns. It is a native of Europe, Western Asia and Siberia. It is very desirable for ornamental hedges.

In 1904, plants 6 to 12 inches high were secured in Pennsylvania and planted in the experimental nursery. Since that time they have not ben injured by freezing in any way. In 1907 they were placed on the college campus and have proved entirely hardy. The buckthorn is much used in eastern United States and Europe for hedges and is valuable for that purpose and for large shrubberies in Montana.

## RHUS.

This genus includes several species of trees and shrubs, with alternate pinnate leaves. Most of the species are beautiful ornamental plants, and if they are adapted to the soil and climatic conditions in which they are to grow they deserve a place in any ornamental landscape. They are propagated from seeds, layers, root cuttings and by hard wood cuttings.

**Smoke Bush:** (*Rhus Cotinus*) When tested at this station it has been found not to be hardy enough to withstand our climatic conditions.

**Chittamwood:** (*Rhus Cotinoides*) This grows into a small tree, but is not hardy at this station.

**Staghorn Sumach:** (*Rhus typhana, var. laciniata*) This plant was set out in the experimental nursery in 1904. The tips killed each year but new shoots came out from below the injured portion and made a growth of from 4 to 6 feet each season. The deeply cut foliage produces beautiful effects in the shrubbery, and while it is not entirely hardy at this altiutde, it will still produce good effects in any landscape.

## CURRANT AND GOOSEBERRY

Besides the common currants and goseberries, there are other species grown for ornamental purposes. There are several native forms of the wild currant and gooseberry growing in Montana which, when placed under cultivation, make desirable ornamental plants. Both make good ornamental hedges when domesticated.

**Golden, Buffalo or Flowering Currant:** (*Ribes aureum*) This is a shrub growing to a height of 8 to 12 feet, with yellow, showy flowers. This and its variety *tenuiflorum* are hardy at this station and are good plants for the shrubbery.

## ROBINA

**Black Locust:** (*Robina Pseudoaccacia*) This tree belongs to the order Leguminosae and has pinnate leaves, with flowers pea-like in form, and seeds borne in pods. It grows to a height of from 60 to 80 feet, and is covered with thorns. It is a native of eastern North America. At this station it is not hardy. About one tree out of one thousand goes through the winter without injury, the others kill back from one-third to three-fourths. At lower altitudes in the state the black locust is hardy and is planted for shade and ornamental purposes.

## ROSES

These include a large number of ornamental deciduous shrubs, only a few species of which are hardy at this station. A few of the cultivated varieties can be grown here by giving them winter protection. Unless one is willing to give particular care and attention to the growing of cultivated roses there are only a few varieties that should be planted.

The following species have been tested at this station:

**Swamp Rose:** (*Rosa Carolina*) This plant grows to a height of 6 to 8 feet and bears single pink flowers. It is a native of eastern Canada, Minnesota and the south. From 50 seedling plants secured in Pennsylvania in 1904, we have found that with slight covering or shade given during the winter months, the plants will survive.

**Many-Flowering Rose:** (*Rosa multiflora*) This species is a native of Japan and China. Fifty plants were secured in Pennsylvania in 1904. They are not hardy, even when given covering during the winter. In the spring of 1907 all had been winter killed.

**Japanese Rose:** (*Rosa rugosa*) This is a native of northern China, Korea and Japan, and is a very variable species. It is an upright shrub, growing to a height of 4 to 6 feet, with stout stems closely covered with spines. The leaves are very dark green and shining above, which gives the plant a striking appearance. The flowers range in color from white to red, and are two to three and one-half inches across. In 1904 fifty plants were put in the experimental nursery. In the fall of that year they did not mature thoroughly before freezing weather and were slightly injured during the winter. Since that time they have not been seriously injured and are now making vigorous growth on the college campus, where they were planted in the spring of 1907. *Rosa rugosa,* with its varieties, is among the best of the rose plants for this latitude. They are valuable for shrubbery or for specimens on the lawn.

**Prairie Rose:** (*Rosa setigera*) At this altitude this species is not hardy. The plants set out in 1904 all winter killed before the spring of 1907.

**Harrison's Yellow Rose:** (*Rosa hemisphearica var. Harisoni*) This is a rather tall form, reaching a height of 6 feet or more. It is very hardy and blooms freely, the flowers being double and of a bright yellow color. The leaves are bluish green and the stems dark red, making it an attractive plant even after the flowers are gone. This rose has not been tested at the station but it is to be found on many lawns in Bozeman and other cities and towns of about the same altitude, where it is perfectly hardy, regularly surviving the winters without any protection. It is to be recommended for general planting.

## RASPBERRY AND BLACKBERRY.

( *Rubus xanthocarpus*) This plant is a native of China and was introduced into the United States by the U. S. Department of Agriculture. It is not hardy at this station and has been discarded.

**Rocky Mountain Flowering Raspberry:** (*Rubus deliciosus*) This plant is a native of the Rocky Mountain region and is hardy at this station. It is not, however, particularly valuable as an ornamental plant.

**Cultivated Red Raspberry:** (*Rubus strigosus*), **Common Black Raspberry** (*Rubus occidentalis*), **Northern Dewberry** (*Rubus villiosus*), and **Common Blackberry** (*Rubus argutus*) are not hardy at this station unless given some covering during the winter months. At lower altitudes in the state these plants are hardy and can be grown without winter protection.

## THE WILLOWS.

The willows include a large number of shrubs and small trees, several of which are native to Montana. Willows are found growing on moist or wet ground and will not thrive under cultivation unless considerable moisture is given them. All the trees of this genus are easily propagated from hard wood cuttings taken in the fall or early spring and planted in moist soil. Several of the native species are valuable for wind breaks and shelter belts, but are not desirable plants for shrubbery groups or lawn planting. Several introduced varieties have been tested here.

**Laurel-Leaved Willow:** (*Salix pentandra*) In 1904 this species was planted in the experimental nursery and appears to be perfectly hardy at this time. The leaves are large, very dark green and shining above. This is a valuable plant for producing quick effects in shrubbery groups.

**Yellow Willow:** (*Salix vitellina*) This species grows into a medium sized tree and is found growing in Bozeman as a street and shade tree. It is not desirable, however, for this purpose, as it does not give a dense shade and the leaves fall throughout the whole summer,—a very undesirable characteristic for the street or lawn.

**Diamond Willow:** (*Salix vestita*) Plants of this species were introduced from North Dakota in 1908 and at this time seem to be entirely hardy. This tree is claimed to be valuable for fence post material, as the wood is said to be very durable in contact with the soil. It is a native of Montana.

## SHEPHERDIA.

**Buffalo Berry:** (*Shepherdia argentea*) This is an upright shrub, reaching a height of from 10 to 15 feet. The young growth and both sides of the leaves are covered with a silvery white coating of hairs. The fruits are about one-fourth inch long, red or yellow, and are much used in Montana for domestic purposes. This plant is a native of Montana and is hardy under cultivation. It is a desirable plant for the shrubbery and also makes a good protective hedge as its stems are covered with thorns.

## THE MOUNTAIN ASHES.

These are among the very best ornamental trees and shrubs which are adapted to growth in Montana. They have a beautiful foliage and the fruits, which are very conspicuous, often remain on the trees until late in the winter.

**European Mountain Ash:** (*Sorbus Aucuparia*) This plant is a native of Europe, western Asia and Siberia. It grows into a round headed tree from 20 to 40 feet high. It is hardy at this station and is one of the very good trees for lawn planting. It is not, however, large enough for street or park planting. When placed on the lawn it produces very beautiful effects. The trunk of the tree is more or less subject to sun scald on the south side during the winter months, and until the trees are four or five years old some shade should be provided for the trunks at that season.

**American Mountain Ash:** (*Sorbus Americana*) This plant grows into a small tree or large shrub and is desirable for ornamental purposes. It is hardy at this station.

**Western Mountain Ash:** (*Sorbus sambucifolia*) This grows into a small tree or shrub and is a desirable plant for ornamental purposes. It is native to Montana.

**Red Choke Berry:** (*Sorbus arbutifolia*) This is a shrub which grows to a height of from 6 to 12 feet. It is hardy at this station and deserves a place in the shrubbery.

**Oak-Leaved Mountain Ash:** (*Sorbus quercifolia*) This plant grows into a small tree, pyramidal in form. The leaves have much the same shape as those of the white oak. At this station it is a slow growing tree, but quite hardy and is desirable for ornamental purposes.

## THE SPIRAEAS.

These form a large group of ornamental deciduous shrubs, with alternate leaves. The flowers are usually small, white, pink, or crimson in color and borne in umbels, corymbs, or panicles. They are mostly low growing shrubs and are well adapted to the borders of roads, walks or shrubberies, or as single specimens on the lawn. They are propagated from seeds, and from hard wood cuttings.

**Douglas Meadow Sweet:** (*Spiraea Douglasii*) This shrub grows to a height of about 8 feet. The branches are brown; leaves oblong to narrow oblong; flowers pink, borne in panicles from 4 to 6 inches long. It is not hardy at this station and must be given protection during the winter months.

(*Spiraea Anthony Waterer*) This plant is not hardy at this station, and kills to the ground each winter.

(*Spiraea Billardii*) This plant is not hardy at this station.

(*Spiraea Japonica*) This plant kills to the ground each winter and is not hardy at this station.

**Bridal Wreath:** (*Spiraea prunifolia*) is not hardy at this station.

(*Spiraea Cantoniensis,*) single, is not hardy at this station.

(*Spiraea Cantoniensis, var. flore pleno,*) double, is not hardy.

(*Spiraea Thunbergii*) This is a very graceful shrub, growing to a height of about five feet. The flowers are white and borne in umbels early in the season. It is almost hardy at this station. The tips of the plants kill back a little each winter, but not enough to interfere with the subsequent growth or flowering of the plant.

(*Spiraea trilobata*) is not hardy.

(*Spiraea Van Houttei*). This shrub grows to a height of 5 or 6 feet and is one of the most beautiful ornamental plants we have grown at this station. It is almost hardy and when given slight winter protection, will not kill enough to interfere with growth or flowering.

*Spiraea Thunbergii* and *Spiraea Van Houttei* are very desirable plants for specimens on the lawn or for the borders of walks and drives or shrubberies.

### SYMPHOROCARPUS.

**Snow Berry:** (*Symphorocarpus racemosus*) This is a shrub that grows to a height of about 4 feet. It is a native of Montana and does well when put under cultivation. It is a desirable plant for shrubberies and when properly trained makes a fairly good hedge.

### THE LILACS.

These are among the most important of our hardy ornamental plants, and the common lilac, at least, is well known.

**Purple Lilac:** (*Syringa vulgaris*) This shrub is well known in nearly all parts of Montana and is entirely hardy. Though very common it is none the less desirable for planting, as its beautiful, fragrant flowers, dense foliage, readiness of growth and variable habit make it well suited for shrubberies, ornamental hedge rows or isolated shrubs.

**White Lilac:** (*Syringa vulgaris, var. alba*) This variety is not quite so common as the purple lilac, but is coming to hold a deservedly prominent place. It is equally hardy, blossoms profusely and the white flower clusters offer a pleasing contrast to the purple ones of the preceding.

(*Syringa Amurensis*) This is a shrub growing to a height of 12 feet. The flowers are yellowish white and borne in loose panicles. It is a native of Manchuria. Seeds were planted in the spring of 1907 and the young plants since that time have been entirely hardy.

(*Syringa Pekinensis*) This is a shrub which grows to a height of about 15 feet, with slender, spreading branches. The flowers are white and borne in large panicles. It is hardy at this station.

(*Syringa villosa;* This is a shrub growing to about 8 feet. The flowers are pinkish lilac or white and are borne in broad panicles. It is hardy at this station.

**Persian Lilac:** (*Syringa Persica*) This is a shrub growing to about 10 feet, with spreading branches. The flowers are either white or purple. It is a very desirable lilac for group planting and is entirely hardy at this station.

**Rouen Lilac:** (*Syringa Chinensis*) This shrub grows to a height of 10 to 12 feet, with slender, arching branches. The flowers are purple red and are borne in large panicles. This is a desirable plant for the shrubbery, and is quite hardy.

### TAMARIX

(*Tamarix juniferina*) Not hardy at this station.

**French Tamarisk:** (*Tamarix Gallica*) Not hardy.

(*Tamarix parviflora*) Not hardy at this station.

### TILIA

**Bass Wood or Linden:** (*Tilia Americana*) This tree is not hardy at this station, although at lower altitudes in the state it makes a desirable tree. It grows with moderate rapidity to fairly large size, is symmetrical in shape and has a dense foliage of large, nearly round leaves. The flowers, while small and rather inconspicuous, are delightfully fragrant, and the clusters of berries, with their peculiar wings, add to the interest of this tree. It should be more extensively grown in localities where it will thrive.

(*Tilia ulmifolia*) This makes a fairly large tree but is of slow growth. Seeds were planted in the spring of 1907 and since that time the young plants have been entirely hardy. It promises to do well in Montana and will make a desirable ornamental tree.

### TOXYLON.

**Osage Orange:** (*Toxylon pomiferum*) Not hardy at this station.

### THE ELMS.

These form a considerable group of ornamental deciduous trees. Most of the elms grow into large trees and are very tall and long lived. They are valued for park planting or street trees.

**White Elm:** (*Ulmus Americana*) The white elm is about half hardy at this station. The young growth frequently kills back, especially on young trees. As they increase in age they seem to get hardier.

It is very difficult to grow young elms at this station without giving them artificial protection during the winter months. At lower altitudes in the state this tree is hardy and is one of the good trees for street and ornamental planting.

**English Elm:** (*Ulmus campestris*) Not hardy at this station.

**Cork Elm:** (*Ulmus racemosa*) Not hardy at this station.

### VIBURNUM.

This genus includes a large number of ornamental deciduous shrubs, the most common of which is the snow ball.

**Arrow Wood:** (*Viburnum dentatum*) This is an upright, bushy shrub, growing 12 to 15 feet high. It is a good plant for the shrubbery group and thrives best in moist soil. It is not entirely hardy at this station, the season's growth often killing back half or more during the winter.

**Snow Ball:** (*Virburnum Opulus, var. sterile*) This plant is almost hardy at this station; the terminal growth, however, is frequently killed back. As it increases in age it seems to become hardier.

## CONIFERS.

There are a number of cone bearing trees native to Montana, which, with several introduced species, are very desirable for ornamental purposes and shelter belts. The conifers are rather hard to transplant successfully, especially if care is not taken in the process of moving the plants. A large number of evergreens have been transplanted to the college campus with comparatively small loss. The best results have been obtained by moving the plants in the spring at the time the buds are beginning to swell. The roots should not get at all dry, and it is necessary to provide shade for the first year or two. This can be given by planting the trees in the shade of buildings or of other trees, or by putting lath screens over the young evergreens. When native evergreens are removed from the mountains, the best results are obtained when the specimens are given preparation one year in advance of transplanting time, by digging a trench or sinking a spade around the tree, thus cutting off all the long roots and causing new branch roots to form near the main trunk. When these trees are transplanted a much more compact root system will have grown and they can be moved with much greater success.

Some of the conifers are very desirable for specimens on the lawn; some for group planting, while others are valuable as shelter belts and wind breaks. Several species have been tested at this station.

## THE FIRS.

**Balsam Fir:** (*Abies balsamea*) Young trees of this species were obtained in Wisconsin and planted in the spring of 1908. During the winter of 1908-9 all the plants died to the ground.

Seeds of this tree were planted in the spring of 1907. Seedling trees have gone through two winters without injury and at this time are making a vigorous growth. It promises to be hardy at this station.

**White Fir:** (*Abies concolor*) In the spring of 1902 specimens of this tree were growing in the experimental nursery. Since that time they have been entirely hardy, never having been injured by climatic conditions. Seeds were planted in the seed bed in the spring of 1907. The small seedlings were slightly injured during the winter of 1908-9, but at this time the plants seem to be recovering and starting into vigorous growth. This promises to be a very desirable tree for ornamental purposes.

(*Abies grandis*) Seeds of this tree were planted in the seed bed in the spring of 1907. The young plants winter killed in the winter of 1908-9. This is a native of the Pacific Coast region, and there grows to a large tree, from 200 to 300 feet high and 4 feet in diameter. It does not promise to be hardy at this station.

(*Abies Nordmanniana*) Seeds of this treen were planted in the spring of 1907. The young seedlings died during the winter of 1908-09. It is a native of the mountains near the Black Sea and Caucasus.

## THE JUNIPERS.

This genus includes a number of ornamental evergreen trees and shrubs. The leaves are more or less scale-like, with inconspicuous flowers and berry-like fruit. Some of the junipers are used for hedges and specimen plants on the lawn. The following kinds have been tested at this station:

(*Juniperus Sabina, var. prostrata*) This is a spreading or procumbent shrub and is not of much value as an ornamental plant. It is a native of Montana.

(*Juniperus Chinensis*) Trees of this species were sent us from the U. S. Department of Agriculture in the spring of 1908. At this time the plants are apparently hardy, not having been injured at all during the winter of 1908-9. This species grows into a tree 50 to 60 feet in height.

**Red Cedar:** (*Juniperus Virginiana*) This is one of the largest of the junipers, sometimes reaching 100 feet. It is common throughout the Rocky Mountain region and the native form and most of the cultivated varieties are entirely hardy. Where it thrives well it makes a rather desirable tree, but with us it is of such slow growth that it does not seem advisable to plant it except for specimen trees on extensive grounds where a very large assortment of trees and shrubs is desired.

## THE LARCHES.

There are two or three species that are native to Montana and they are the only deciduous conifers native to the state. Some grow into large trees and are desirable for ornamental purposes. The following varieties have been tested here:

(*Larix occidentalis*) This is a tall tree, often growing to a height of 150 feet. The leaves are light green and deciduous. It is a native of western Montana and is hardy at this station.

**Tamarack:** (*Larix Americana*) This tree grows to a height of 60 feet. It is a good plant for ornamental purposes in Montana and is hardy at this station.

## THE SPRUCES.

These are mostly hardy ornamental trees and several are native to Montana. The trees grow in pyramidal form, with spreading branches. Several kinds have been grown at this station.

**White Spruce:** (*Picea alba*) Plants of this species were secured in Minnesota in the spring of 1908, but died to the ground in the winter of 1908-9. The tree is native to parts of Montana and will no doubt prove hardy in most parts of the state.

**Engleman Spruce:** (*Picea Engelmanni*) This is a very desirable ornamental tree, growing to a height of about 150 feet. It is native to parts of Montana and is hardy at this station. It is a very desirable tree for group planting on the lawn and for shelter belts or wind breaks.

**Norway Spruce:** (*Picea excelsa*) Plants of this species secured in Wisconsin and set in the spring of 1908 were killed back about one-third in the winter of 1908-9. This species promises to be hardy at this station after it is thoroughly acclimated, and is one of the very good trees for shelter belts or wind breaks.

**Colorado Blue Spruce:** (*Picea pungens*) This grows into a tree from 80 to 100 feet in height. The branches are nearly horizontal and grow out from the main stem in apparent whorls. The tree takes a pyramidal form. The color of the leaves on different trees varies from dark bluish green to a silvery white. It is a native of the Rocky Mountain district of Wyoming and Colorado. It makes a very beautiful tree as a specimen on the lawn and is absolutely hardy at this station. This is probably the best of the evergreens for ornamental planting in Montana.

### THE PINES.

There are many pines and several of them are native in Montana. Few, however, have much value here as ornamenal trees. The following kinds are hardy at this station: *Pinus Austriaca, Pinus monticola, Pinus Mughus, Pinus Murrayana, Pinus palustris, Pinus sylvestris, Pinus Koraiensis and Pinus ponderosa, var. scopulorum.*

(*Pinus Koraiensis*) This plant grows into a tree about 100 feet high. The leaves are dark green and glossy above and bluish white on the inner sides. They are from two and a half to four inches long. It is a native of Japan and Korea. It is of rather slow growth but forms a dense, broad pyramidal head. Seeds of this plant were sent us from U. S. Department of Agriculture and sown in the spring of 1907, since which time the young plants have been entirely hardy.

**Yellow or Bull Pine:** (*Pinus ponderosa*) This plant is a native of Western Montana. Seeds were sown in the station nursery in the spring of 1907. The young plants died in the winter of 1908-9. Tests will be continued with this variety and it is probable that the larger trees will prove hardy. Several trees of this variety on the college campus are doing well and have not killed back.

**Mugho Pine:** (*Pinus Montana, var. Mughus*) Seeds of this plant were placed in the seed bed in the spring of 1907. The young plants have been entirely hardy since that time and promise to be hardy at this station.

### PSEUDOTSUGA

**Douglas Spruce:** (*Pseudotsuga Douglasii*) This tree is a native of Montana and is perfectly hardy at this station. It is valuable for shelter belts and wind breaks, and is also good for group planting upon the lawn. It is a fast growing evergreen and one that is comparatively easy to transplant.

### TAXUS.

**Yew Tree:** (*Taxus baccata*) Seeds of this tree were planted in the spring of 1907. The small seedlings died in the winter of 1908-9. The tree does not promise to be entirely hardy at this station.

### THUYA.

**Common Arborvitae:** (*Thuya occidentalis*) This plant grows into a tree 60 feet in height. There are a large number of varieties in this species, some of which are desirable for ornamental purposes. Seeds of this tree were planted in the spring of 1907 and the young seedlings have been entirely hardy.

(*Thuya gigantea*) Seeds of this tree were planted in the spring of 1907. The young seedlings died during the winter of 1908-9. This tree is native in parts of Montana and very likely will prove hardy at this station as the trees increase in age.

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MONTANA AGRICULTURAL COLLEGE
EXPERIMENT STATION

BOZEMAN, MONTANA

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# Planting Trees and Shrubs on the Dry Farm

BY

O. B. WHIPPLE,
*Horticulturist*

The people who have but recently made their homes on the dry farms of the State will hardly fail to appreciate the value of trees when looked at purely from the standpoint of pleasure. Some who have lived on these dry farms longer may have, in a way, become acustomed to their surroundings and the absence of trees no longer causes discontent. They have gradually come to believe that trees and shrubs cannot be grown under existing conditions. And possibly there are a few who do not appreciate trees and shrubs. However, as a protection from the glaring sun and drying winds in summer and severe cold in winter, trees and shrubs properly planted and cared for cannot but add to the comfort of the home, and, to most of us, contribute no little amount of pleasure. But comfort and pleasure are not the only returns the planting of trees and shrubs may bring to those upon the farm. There are those who claim that the planting of trees in large numbers upon the plains would greatly modify the climate of these regions, that the rainfall would be increased, and that drying winds would be less frequent. And trees are sometimes planted, even on the dry farm, with a view to financial returns. The wood lot or the shelter belt does, in some cases, furnish

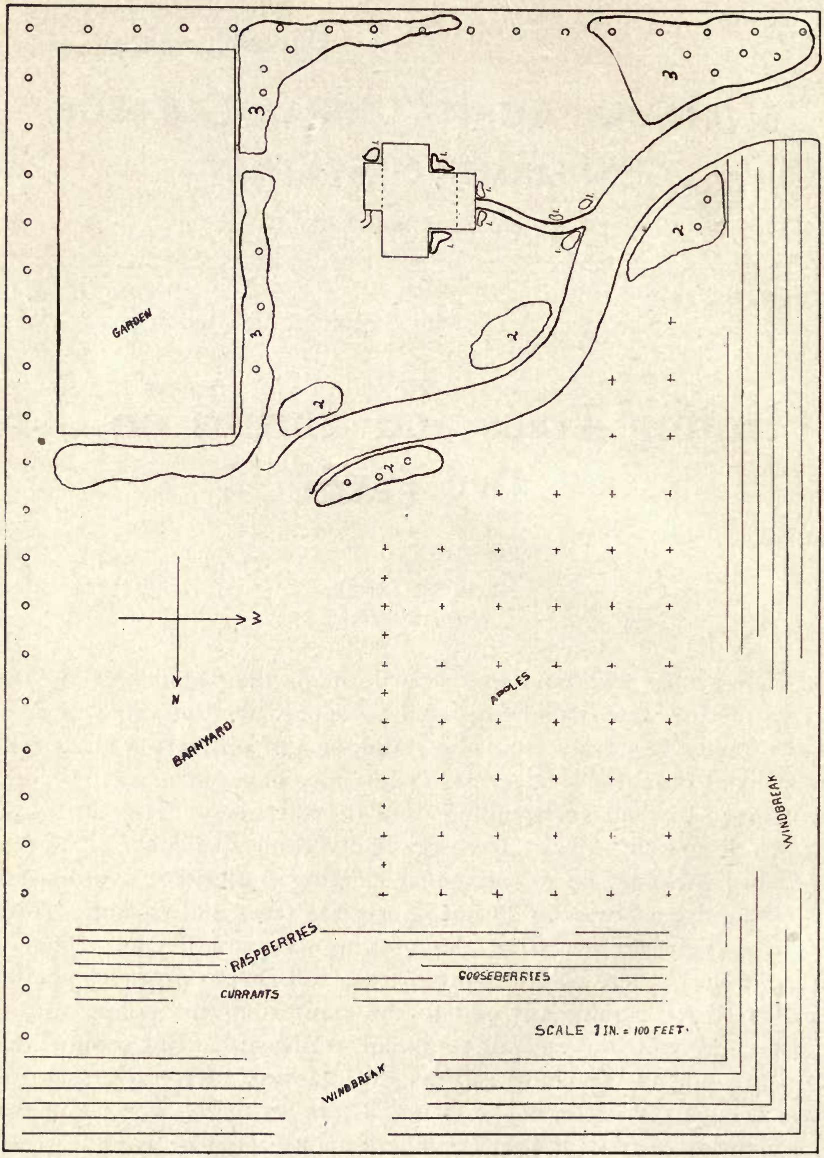

FIG. 1. Small circles indicate trees. Areas numbered 1, good locations for small shrubs; 2, groups of shrubbery not too thickly planted and with the smaller ones to the outside; 3, masses of shrubbery with the taller ones in the rear. Row of plum trees next to barnyard.

fuel for the home and posts for the fences. Surely the fruit garden is both a source of pleasure and of an income that may be figured in dollars and cents.

Many farm homes have been improved by growing trees under conditions as trying as those found on the dry farms of Montana. It is surely worth a trial. When the matter is all summed up, we find that the degree of success is measured largely by the proper selection of plants, proper selection and preparation of soil, and proper planting and proper care of the trees and shrubs.

## SELECTING THE SITE.

In many cases the location of the farm home is definitely fixed, the plan is already started and the problem is to complete it, but there is much to be gained in the proper selection of the site. Most of us have more or less positive ideas as to how the farm should be arranged for convenience. Some no doubt give it little thought. Most people prefer to have the home near the highway, and, keeping this one thought in mind, the house should otherwise be about centrally located. While it is in some ways convenient to have the house at the cross-roads corner, it may cause a waste of time in going to and from work and in most cases it results in greater difficulty in planning and planting. While not always possible, it is under most conditions more desirable to have a south or east front. If one must have a wind break to the north and west it is hard to front the house in these directions. Still there are ways of overcoming this difficulty as shown in figure 1.

Do not make the mistake of plotting into fields all the tillable land on the farm and leaving the rest for the home grounds. It is impossible to grow trees, shrubs, and especially lawns, upon poor soil. An attractive home lot will do more to increase the valuation of the farm than the best ten-acre field on it.

Occasionally there is a limited amount of irrigation water to be had. If possible, locate the home where this may be used on the garden, orchard and lawn. It will yield greater returns here than on any other part of the farm.

## PROTECTING THE HOME GROUNDS.

One of the first points to be considered after the selection of the site for the home is that of proper protection of the grounds from your own and from your neighbors' stock. Trees and shrubs and garden vegetables planted upon the dry farm can be expected to thrive only when given the best of care and protection. While the trees and shrubs may need pruning and the orchard frequent cultivation, cows and horses are poor pruners and hogs hardly follow approved dry farm practices in such cultivating as they may do.

The fence should be high enough and strong enough to turn all kinds of live stock, with the possible exception of chickens. It should extend around the entire grounds and should be set out far enough to prevent stock from reaching the plants in any way. As a rule the barnyard should be fenced off from the rest of the grounds, especially if stock is allowed any freedom at all about the barns. The one who tends the garden will usually realize the importance of having it fenced, especially as a protection against the chickens. Do not plant your home grounds and then build the fence; build the fence first.

## PLANNING THE HOME GROUNDS.

Some attention should be given to planning the yard for convenience. The house should be convenient to the orchard, the garden, and the barnyard. But it should be in a yard of its own, separate and distinct from the other portions of the grounds. It should be far enough from the proposed wind-break so the snows which drift inside the shelter will not be annoying about the house. The barns should be located with the same thought in mind.

The orchard and the fruit garden should be located where they will be well protected by the wind-break; if they receive the drifting snows, so much the better. Snow is the best of protection for small fruits, and, if caught and held within the orchard, supplies much needed moisture. The entrance may be planned to serve equally well the house and the barn, or, better still, have a front entrance to serve the house and a side entrance to handle the larger part of the travel to the barn.

The house should be located far enough from the road to pro- a good foreground,—we cannot make a good picture without a foreground,—and the barn should be far enough from the house to allow for a good back yard and screen of shrubbery between the yard proper and the barnyard. Do not be afraid of setting aside ample land for the home grounds. Five acres, if well planned, is not too much and a smaller space does not allow for good arrangement.

## PREPARATION OF LAND.

The land to be planted to the home grounds should be well prepared and fallowed at least one year before any attempt is made to start trees and shrubs. The land should be deeply plowed, and under most conditions fall plowing would be preferable. During the following summer it should be well cultivated to keep down the weeds and conserve the moisture. If it is not practicable to keep the whole yard area cultivated, particular spots chosen for the location of clumps of trees or shrubs may be given a good mulch of straw or coarse stable manure. This will keep down the weed growth and conserve the moisture.

In plowing and working the land, avoid ridging it in places where rows of trees are to stand. On the contrary, the land should be so prepared that the rains will drain toward the newly planted trees. Be sure to cultivate well the area to be occupied by the orchard, the small fruit garden, the wind-break, and especially the yard, if an attempt is to be made to grow a lawn. If rows of trees are to be planted on the borders of the yard opposite the windbreak, it will be desirable to plow and summer fallow strips of land at least ten feet wide here.

## SELECTING AND BUYING THE PLANTS.

Under such adverse conditions as prevail on our dry farms, it is only natural that one of the most frequent causes of failure is the improper selection of plants. The newcomer brings his ideas with him and attempts to work them out under conditions entirely different from those he is accustomed to. One cannot hope for success in growing trees and shrubs unless he has made the proper selection of varieties to begin with. It is no doubt true that there is much yet to be learned about selection of plants for Montana conditions. But observations made in our own State and experiments carried on here and in other States, under similar conditions, have suggested some of the most promising kinds. Further experiments may lengthen this list.

Many are undecided as to where they should purchase stock. In the first place we may say that it should be bought of a well established nursery, a nursery that has developed some respect for its reputation. It is also safe to say that the trees should be bought as near home as is possible. The local nursery is generally able to furnish kinds adapted to your conditions, and the stock from the nearby nursery has a better chance of reaching you in good condition than that from a distance. If you cannot buy stock near home, it is probably best to try some northern nursery, where varieties adapted to our conditions are more likely to be carried in stock. If the desired variety cannot be purchased of the northern nurseryman, one need not hesitate to buy the stock wherever it can be found.

One should buy a good quality of plants, and under our conditions it is best to buy young plants. They are cheaper and more likely to grow. Forest tree seedlings one or two years old may be started more readily than older trees. Apple grafts one or two years old are safer to plant than older ones,—and they will bear fruit just as soon as the older trees. At least insist on first-class fruit trees. One-year-old apple trees should be straight whips from three to four feet high. Two-year-old apple trees are generally branched and should have the lowest branch not over two feet from the ground and should have four or more branches.

Orders should be placed in early fall for stock to be delivered the following spring. As soon as the trees arrive they should be unpacked and heeled-in in some shady place, as on the north side of a building, or stored in a cool cellar. They should be kept cool to retard the growth of the buds and moist to prevent them from drying out. In heeling-in the trees dig a trench and set the roots well down in the moist soil and tramp the earth well about them. If the soil is not quite damp it is best to settle it about the roots with water. If the weather is drying, and especially if the trees look rather dry on unpacking, it is best to bury them root and top in moist soil. If everything is in readiness to plant the trees when they arrive, they may be planted at once. Should they appear dry, it is best to soak them in fresh water from twelve to twenty-four hours before planting. Trees planted in a shriveled condition are seldom able to revive, while the same trees freshened in soil or in water may make a successful growth.

### SEASON TO PLANT.

Under Montana conditions, trees and shrubs should be planted in early spring, as soon as the native vegetation starts. The young plant must start growth on the food material stored up in its root, trunk and branches. If the planting is delayed until the plants have leafed out, this leaf surface generally dries up and food used in producing it is lost. With its supply of food diminished in this manner, the plant has its chances for surviving reduced proportionally.

### HOW TO PLANT.

Before setting the plants in the ground, trim off all broken ends of roots, and if any roots are exceptionally long, cut them back to six or eight inches in length. Handle the trees carefully to avoid drying the roots. A good way is to haul them to the field in a barrel with enough water to cover the roots. Take them from the barrel as they are to be planted.

To plant forest tree seedlings or small hedge plants, push the blade of the spade down into the ground and work it back and forth until the roots of the tree may be slipped down behind it. Remove the spade and tramp the soil well down about the roots. If a little water may be poured into the hole before the soil is pressed back about the roots, so much the better. In either case, after the tree is planted and the soil is well packed about the roots, see that the surface soil is loose enough to prevent rapid loss of moisture.

It will pay to plant the fruit trees, shade trees, and shrubs with a little more care. Dig a good hole and spread the roots out well. In all cases set the plants three or four inches deeper than they stood in the nursery. The tops should be pruned after the trees and shrubs are set. Cut the forest tree seedlings back to within a foot or even six inches of the ground. Prune the shrubs and small fruit plants the same way. If one-year-old fruit trees are set out, cut the whip off two feet above the ground. If two-year-old trees are set, thin out the branches to four or five, leaving those that are spaced as far apart as possible, and cut these back to within six inches of the trunk.

## CULTIVATION.

During the first summer, the orchard, windbreak, and small fruit garden should receive good, clean cultivation. Rows of shade trees and hedges should receive the same care. Individual plants or clumps that cannot well be cultivated may be mulched with straw or coarse stable manure. The orchard and small fruit garden should be well cultivated as long as they are maintained upon the dry farm. The windbreak should be cultivated as long as it is possible to get between the trees.

The orchard should be plowed occasionally to induce the trees to root deeper. Fall plowing is generally more satisfactory than spring plowing, and one plowing in two years should be sufficient. One may plow six or eight inches deep in the middle, running a little shallower near the trees to avoid breaking the main roots. Cutting some of the small roots will not injure the trees.

It may be well to mulch the soil about the young fruit trees and shrubs, the first winter at least. If mice are inclined to be troublesome, the mulch should not extend up to the trunks of the trees. To prevent injury by mice, pile a cone of earth eight inches high about the base of the tree and then mulch outside of this. Bush fruits may be protected by bending them down to the ground and covering them with earth. Raspberries especially need this protection. If the currants and gooseberries are planted near the windbreak where they will be partially covered with snow, they will need no other protection.

## THE WINDBREAK.

The purpose of the windbreak is one of protection. It should protect the buildings and the fruit and vegetable gardens from sweeping winds. In winter it should stop the blowing snow and prevent it from piling up about the buildings. Such protection adds much to the comfort of the home, and without some such protection from drying winds, it is almost useless to attempt to grow fruit upon the dry farm. In summer the windbreak checks the winds which rob the soils of the garden, orchard and yard of their moisture. If it is to serve these purposes it must be dense enough and wide enough to stop the wind. To make it dense, it must be made up of trees of varying habits of growth. A grove of cottonwoods will not serve the purpose, as the lower limbs soon die off and allow the wind to

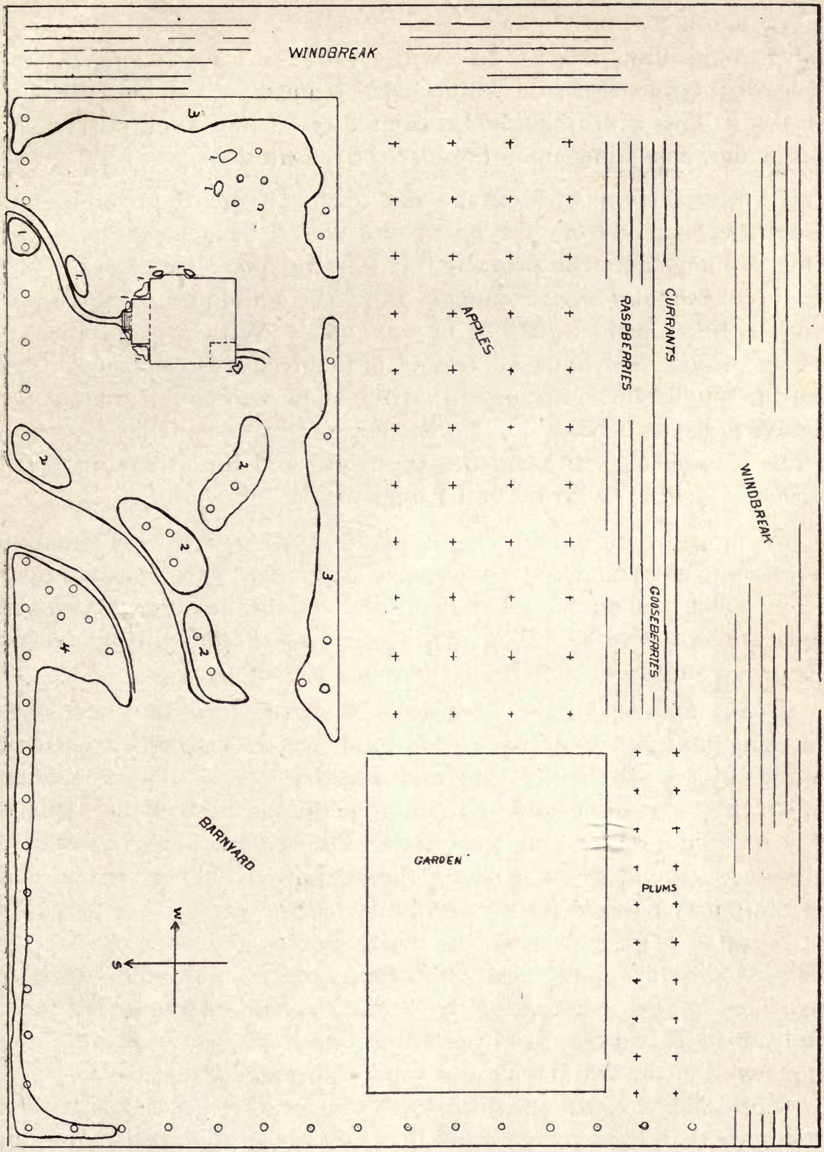

FIG. 2. Small circles indicate shade trees. Aread numbered 1, small shrubbery; 2, larger shrubs in center, smaller ones to outside, not planted too closely; 3, masses of shrubbery with tall shrubs in rear and smaller ones in foreground; 4, mass of tall shrubbery or hedge of tall-growing shrubs. Scale: 1 in. = 100 ft.

rush through underneath. Nor will a grove of low-growing shrubs serve all the purposes of a windbreak. It must be a combination of the two. The width should be from fifty to one hundred feet, or even wider, depending upon the force of the winds.

In most sections of Montana east of the Divide, the troublesome winds are largely from the north and west. This means that the home grounds must be protected at least on these two sides. The windbreak should be far enough from the buildings so the snow which collects inside will not be annoying. With a properly constructed break one hundred feet is probably a safe distance. The planting should be so arranged that the snow will collect among the trees as much as is possible. To encourage this the smaller trees and shrubs should be planted to the windward and the others arranged in order of height, with the taller ones inside.

In figure 2 the windbreak is made up of one row of Russian olive on the north and west, one row of box elder next, then two rows of box elder and green ash mixed, and on the inside two rows of poplar or cottonwood. The drifting snows should pile up within this grove and greatly increase the moisture supply.

In the makeup of the windbreak, the most promising trees are the Canadian poplar, native cottonwood, box elder, golden Russian willow, green ash, white elm and Russian olive. The Canadian poplar (*Populus balsamifera*) is one of the hardiest of the poplars. It is a rapid grower and lasts well. The common narrow-leaved cottonwood found growing along the streams in the eastern part of the State may be used for the windbreak or the yard. It is probably not so rapid a grower as the Canadian poplar and does not last as well. It should not be used when the poplar can be secured. The box elder is also a native of the State and will thrive under most conditions. It is a tree of rather straggling habit, grows rapidly and serves well in the windbreak as a tree of intermediate growth.

The golden Russian willow will succeed on good soil with a little more than the average rainfall. It makes a rapid, dense growth, may be trimmed low, and where the conditions are favorable it is an excellent tree for either the outside or the second row in the windbreak. The green ash is found growing along the streams of eastern Montana. With good care it may be induced to grow on the dry farm, especially when planted in groves. It is not so rapid a grower as the other trees mentioned, but it is a more permanent tree. For this reason it is well to alternate this tree in rows with the box elder and poplar, with the idea of removing the shorter-lived trees as they begin to crowd. The white elm thrives in some sections of Montana. In sections where the growing season is not too short and where the rainfall is a little above the average, the elm may work out well as a windbreak tree. It is a long-lived tree and may be alternated in the rows with poplars, as it grows quite slowly at first. The Russian olive (*Elaeagnus angustifolia*) is one of the hardiest plants available for windbreak purposes. It is a small shrub or tree rarely growing over fifteen feet in height. It makes a low, compact growth, and for that reason makes a first-class tree for the outer rows. It has a thorny growth and will turn live stock when planted closely. The tops may die out as the plants grow older, but they grow up from below again. It should be used in preference to the golden Russian willow where there is doubt as to the willow's being adapted to the conditions.

Of course, the evergreens are not so promising for the dry farm. Yet after they have become established they resist drouth and severe weather even better than some of the trees just mentioned, and they would surely make ideal windbreaks. It is possible that after a shade is once produced the bull pine may be started among the other trees. Attempts should be made to start only small specimens, those not over a foot high.

In arranging the windbreak, the rows of trees should be placed from eight to ten feet apart, with the trees from four to eight feet apart in the rows. The trees in the outside rows may be planted as close as four feet, while permanent trees should stand eight feet apart. Where the ash and box elder are planted alternately, plant the ash eight feet apart with a box elder between.

## PLANNING AND PLANTING THE YARD.

The planning of the yard should have the same careful consideration as does the planning of the home. Not only the convenience of the place but especially its attractiveness depends upon proper planning and planting. Considered from the standpoint of beauty alone, the yard may be planted by the same rules as those which the artist follows in painting a landscape. For after all the yard is to become a picture or a series of pictures, good or bad, depending upon the skill displayed in planning it. The artist would not paint a home scene with the house the foremost figure. He would not picture the entrance to the grounds as a straight lane terminating at the door of the barn, giving an unobstructed view of barnyard scenes, which are at best seldom attractive. Nor would he bound the yard by four lines of trees or shrubs, with no attempt to break the monotony by filling in the corners and planting here and there a clump of shrubs to break up the straight lines. So we should apply these rules to the planting of the home yard, and make the house the central figure but not the foremost. The trees and shrubs should come to the foreground at the sides of the picture. Trees may be planted along the front border of the lawn provided they are pruned up enough from below to give a good view of the yard from the highway. Hedges are more often used to screen unsightly portions of the home grounds, and unless one is ashamed of the front yard, they should seldom be tolerated as a front yard fence.

If the yard is small and there is no place for curved drives, the lane should at least make a slight curve after it passes the house; then a few trees and shrubs properly placed will screen the barnyard from the entrance to the grounds. If necessary to plant windbreaks made up of trees and shrubs planted in straight lines, the picture may be greatly improved by filling in the square corners with smaller shrubs and by planting clumps of shrubbery here and there inside the windbreak where it borders the yard proper. Small shrubs may be planted about the house to unite the house more or less with the lawn and to break up the straight lines. They should be used to fill in all retreating angles about the foundation of the house. Shrubs to be planted about the house should be selected and located with some care. In the first place they should be largely low-growing shrubs. So long as it does not cover a window or crowd a doorway, a tall shrub like the lilac or honeysuckle may occasionally be used in some deep retreating angle about the house. Avoid planting trees and shrubs in places where they obstruct views from windows. If clumps of trees are planted about the yard, a few low shrubs planted near them will have the effect of finishing the picture.

A screen of shrubbery should separate the barnyard from the yard proper. This should be far enough from the house to give a roomy back yard which may serve as a children's playground, clothes' yard, etc.

A row of trees may border the lawn on the two sides opposite the windbreak. They should not be low-growing trees, however. Remember that at least from some points along the highway one should get a clear view of the lawn and of most of the house. If the yard is large, clumps of trees or even single trees may be scattered about the front and back yard. In planting trees and shrubs about the home it is in most cases desirable not to mix the planting too much. In other words, group together in one part of the yard a few lilacs, in another corner a few honeysuckles, etc. A clump of five lilacs, with a background of other shrubs, looks better than a clump made up of five different kinds of plants. Avoid crowding the yard full of trees and shrubs. Leave a goodly portion of open lawn. If the yard is small, one tree with a few shrubs about it will look better than a group of five trees with the additional shrubbery which would crowd the lawn.

The shrubs used in the yard must be selected from a rather limited list. The Russian olive may be pressed into service as a yard shrub. It makes a very good appearance when used in masses about the border, as a hedge or as a screen. Two forms of the Siberian pea tree (*Caragana arborescens* and *Caragana frutescens*) are among the hardiest shrubs. The first mentioned grows to a height of fifteen feet, but it is useful as a shrub to be planted in masses or in hedges and screens. It will take it several years to reach this height, and as it will stand severe pruning it may be kept down quite low. The other is a smaller shrub which grows into more graceful specimens. It is a useful shrub to plant about the house or about clumps of trees upon the lawn. Both forms produce rather showy yellow flowers.

The common lilac succeeds very well in trying locations. It may be used as a hedge plant in the screen, or as specimen plants about the lawn. It grows into a graceful shrub or high hedge with little pruning. The Tartarian honeysuckle should thrive under dry farm conditions. It grows to a height of ten feet and forms a very graceful specimen plant with small but fragrant blossoms. It is a good plant for high hedges or screens or for filling in corners about the border of the yard. The buckthorn is another desirable shrub for hedges or screens. It stands pruning well and will make a stock-proof hedge. It should prove hardy under most conditions. Any of the taller-growing trees suggested for the windbreak may be used in the yard.

Unless one is content with the native grasses or some of the brome grasses, the dry farm home can hardly have a lawn. Still these grasses are better than none at all. There are many farm homes where a limited amount of water is available for irrigation purposes, and in such cases one may grow a mixture of white clover and blue grass.

## THE FRUIT GARDEN.

Too much should not be expected of the fruit garden upon the dry farm. It will serve its purpose and serve it well if it produces enough fruit for the home. The hardy varieties are not always of the best quality, but they must be selected for the dry farm The varieties should also be chosen for a succession of fruit; summer, fall and winter varieties should be planted.

The fruit garden should be located in a protected corner of the home grounds. In many cases it is well to have it located between the buildings and windbreak. In such a position it catches the snow and occupies space that would otherwise be left vacant, if we follow the suggestion of placing the buildings well away from the shelter to avoid snow. The small fruits should be nearest the windbreak, as the drifting snows will protect them most and seldom cause any damage from breakage. One can hardly expect anything in the way of fruit to grow within thirty feet of a windbreak.

Small fruits like the currant and gooseberry should be planted in rows from five to six feet apart, with the plants from four to five feet apart in the row. Raspberries should be planted in rows six feet apart, with the plants four feet apart in the row. Apples should be planted thirty feet apart each way, and if one cares to devote one row in the orchard to plums, the trees may be planted as close as fifteen feet apart in the row. The arrangement of the fruit garden is illustrated in the figures.

The following varieties of fruit promise to be of value on the dry farms of Montana:

Currants: Cherry, Red Dutch, White Grape.

Gooseberries: Houghton, Downing, Champion.

Red raspberries: Cuthbert, Ruby.

Plums: De Soto, Forest Garden, Hawkeye, Wolf.

Apples: Yellow Transparent, Duchess, Wealthy, Gideon, Northwestern Greening, Okabena.

Crab apples: Hyslop, Whitney.

Pears: A few Flemish Beauty and Bartlett trees may be planted for a trial.

Probably little can be expected of the raspberries unless the canes are covered during the winter. The plants should be pruned in the fall, leaving six or seven new canes (canes that grew from the ground during the season) in each clump. These may then be cut back to three feet in length. Cover these canes just before the ground freezes by gathering each clump together and pulling it down to the ground where it may be pinned down with a shovel or two of soil. Then with a single horse and plow throw two furrows from each side up over the prostrate canes. The covering need not be deep; just enough to hold the plants down. The canes should be lifted in the spring just as the buds are beginning to push out. This can be easily done with a pitchfork. The dirt may be worked back to the middle with the hoe and cultivator. The currants and gooseberries should need no protection, especially if planted where the snow will collect over them.

In attempting to grow these small fruits upon the dry farm one should keep the plants well pruned out. Do not let too many of the new canes grow in the clumps of raspberries. Allow seven or eight new canes to grow in each clump each season. Keep all the others hoed out. Prune the gooseberries and currants enough to keep them growing vigorously.

The dry farmer may have some success with strawberries if willing to give them careful attention. The Senator Dunlap seems to be one of the most promising varieties. The plants should be set in rows four feet apart and should not be allowed to become too thick in the row. The ground may be cultivated, or possibly it will be just as well to keep down the weeds and conserve the moisture by mulching the space between the rows. Straw may be used for this if it can be kept from blowing off. It should be about three inches deep and should be extended to cover the plants during the winter. The part over the plants should be raked off to the vacant space between the rows as growth starts in the spring.

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natural protections from the heat of summer and the bleak winds of winter and their absence can be explained only on the false assumption that the usual shade trees and vines will not grow in this climate and that native trees are undesirable.

## WORK AS LIBRARIAN.

In addition to my work as botanist, it has also fallen to my lot to act as the librarian of the Station. I have had general charge of the work of completing the various sets of state and governmental publications received by the Station and am glad to report that in addition to the forty-six volumes of the Bulletins and Reports of the various Experiment Stations of the different states bound last year about 180 more volumes have recently been completed and sent to the binder, so that, although a number of them yet remain more or less imperfect, we shall have an almost complete set of these valuable publications for consultation in the work of the Station. In addition complete sets of the bulletins of this Station have been sent to every public library in the state, so as to make them more available to the general public. This is now the more necessary as many of these bulletins are out of print and it was only with the greatest difficulty that sufficient numbers were obtained to complete these several sets. In order to make the various subjects embraced in our publications more accessible, an index covering the entire period was prepared for Bulletin No. 28 and has been continued in each annual report succeeding. I have also had general oversight over the work of mailing the bulletins of the Station and I would recommend that the mailing list be printed and the mailer be used throughout for the work of issue. One other pressing need for the Station library is that all the books belonging to the Station be properly labeled and catalogued with a card-index of titles and subjects, as this would make available a great mass of special agricultural literature now unknown and needed for the work of the several departments of the Station.

# ENTOMOLOGICAL DEPARTMENT.

R. A. COOLEY, Entomologist.

The experiences of the year have shown the great need of entomological research in Montana. A large amount of damage is being done by native insects, and very little light, comparatively, has been thrown on their habits and the ways to combat them, many species never having received more than passing mention in entomological literature. These, as well as many introduced species, well known elsewhere, for their destructiveness, demand attention in order that their habits may be worked out and remedies or preventive measures devised.

Montana is enjoying with the rest of the country a season of almost boundless prosperity, parallel with which is a great mercantile activity. Many heavily loaded trains bearing agricultural products and merchandise cross our borders from the outside each day. The invariable experience of the past has been that such mercantile practices are responsible to a great extent for the spread of injurious insects from one country or section to another. We do not hesitate to say that many insects are being deposited in the state from other places each year.

The following list gives the names of species that have been detected in the state and which are believed not to be native of Montana:

and the elm are unsuited to the climate, although the latter and the bur-oak are growing in sheltered locations at Bozeman. The box-elder does well at Helena, but is clearly not adapted to most of these valleys, and the same may be said of the linden and the two species of ash, although the green ash can be made grow in many places. All the birches and the mountain ash are here in their prime and nearly all the species of evergreen flourish. The silver poplar and the European willows will grow under ordinary conditions, although the first has been found rather tender and the weeping willow is yet doubful. The Lombary poplar winter-kills here badly and the dead central trunks become unsightly, but the Russian poplars seem perfectly hardy.

All the vines first mentioned as adapted to the plains region also do well in these valleys, but the season is too short for many of the annuals, like the flowering clematis and the morning glory, as they are apt to be killed by early frosts before they have attained their perfection.

3. The Western Valleys, including the Flathead, the Bitter Root, Clark's Fork and the Kootenai, where the rainfall is greater and the temperature more uniform, avoiding the extremes of heat and cold found east of the Divide. This is pre-eminently the horticultural section of the state and in many parts of this region, with irrigation, the same shade trees and ornamental plants may be grown as in the eastern states. The elm, buckeye, horsechestnut, the maples, oaks, the locust (*Robinia pseudacacia*), the honey locust (*Gleditschia triacanthos*), as well as all the trees grown in the other sections of the state, can be grown here without difficulty. The Lombardy poplar and the Carolina poplar appear to be favorite trees of the Bitter Root region and the Balm of Gilead is everywhere planted, while the two species of ash, the mountain ash, the willows and birches with the evergreens of common cultivation are more or less frequent.

All the ornamental vines mentioned in the first group will do well here and in addition a large number, if not all of those found adapted to Massachusetts, New York or Michigan, provided sufficient water can be supplied during the drier parts of the summer. Although I am not aware that any experiments have yet been made, there is no climatic reason why the Boston ivy

(*Ampelopsis tricuspidata*), the various honeysuckles including our native species (*Lonicera ciliosa*), the bittersweet (*Celastrus scandens*), the Aristolochia, the various species of clematis, the matrimony vine (*Lycium Chinense*) and even the grape should not be made grow in many localities with proper care.

4. MOUNTAINS above 5,000 feet. Curiously enough this line limiting the successful growth of crops, such as wheat, oats and potatoes, appears to be some 2,000 feet higher east of the Continental Divide than west of it in the Flathead region, although further south this line of climatic stress rises till at Deer Lodge and in the Bitter Root valleys it is nearly the same on both sides of the range, (5,000 feet).

There are many mining towns and camps and a number of summer resorts above this line of cultivation, which also limits the growth of most of the shade trees. Here it will be necessary to fall back upon the native trees, as few introduced species can stand the climate. The Balm of Gilead can be grown successfully up to 6,000 feet, or even to 6,800 in the mountains in the plains region. The quaking asp (*Populus tremuloides*) can be grown in wet situations up to 8,000 feet, but is best used to form groves about springs or to form shelters for dwellings in the more exposed situations. In the lower situations near this line the native alder (*Alnus tenuifolia*), and birches (*Betula papyrifera*) and (*B. occidentalis*), the mountain ash (*Pyrus*), the native willows and the various species of native pine, fir and spruce will furnish a fair variety for shade, shelter and ornamentation, while the beautiful native flowering clematis (*Clematis Columbiana*) can be made to trail over verandas, fences and shrubbery in a way that cannot be done at lower altitudes, while irrigation will rarely be found necessary except on the drier mountain sides. It is probable that the cut-leaved birch (*Betula alba laciniata*) and the pendulous mountain ash, as well as many of the spruce, firs and other cultivated conifers can be planted successfully.

As yet, this ornamental planting is confined largely to the the cities and towns possessing water-works or an irrigation system, but there are many country homes that rival these city habitations; yet it is surprising to see how few houses and yards even in the larger towns and cities have these beautiful tics desired of grasses suitable for planting on these worn-out ranges. Experiments are being conducted at this Station and, if other species are found to meet our needs, the matter will be called to the attention of the stockmen.

3

## SHADE TREES AND ORNAMENTAL VINES IN MONTANA.

As the result of observations in the different parts of the state and of the work at the Station, it is now possible to determine with fair certainty many of the shade trees and ornamental vines adapted to the climatic conditions of Montana. These results have been published in the First Farmers' Institute Annual (pp. 202-210), but a brief summation will here be given for the benefit of those who have not access to that report.

For general agricultural and horticultural purposes the state of Montana may be divided into four general divisions determined by climate:

1. The Eastern Plains, comprising mainly the valleys of the Missouri and Yellowstone below the mountains with their immediate tributaries, the conditions of the higher benches and uplands being more nearly that of the next.

The most reliable and most satisfactory shade tree here is the common cottonwood (*Populus deltoides*) of the bottoms and its near but more graceful relative the Carolina Poplar. The Lombardy poplar (*P. dilatata*) should do fairly well in this region, although it does not appear to have been planted to any extent, and its tall spire-shaped habit would make in very effective in beautifying the landscape in the wider parts of these valleys. The silver poplar also flourishes here, but as elsewhere sprouts badly. Russian poplars have been found hardy and the European willow (*Salix fragilis* or *S. alba*) are perfectly adapted to this region and the latter lends a pleasing variety to the wide leaved trees usually planted, while the weeping willow (*S. Babylonica*) is still more ornamental and can be grown here wherever there is sufficient water for irrigation.

The green ash (*Fraxinus viridis*) is a native throughout most of this region, but is not as good a shade tree as the white ash (*F. Americana*), which has already been planted to some extent and seems fairly well adapted to the climate at the lower elevations.

The linden or linn (*Tilia Europæa* and *T. Americana*) grow well here wherever they have been planted and the various maples will also be found hardy, probably as far up as Great Falls and Billings, while the box-elder (*Negundo aceroides*) is everywhere planted. Three of the oaks have also been found hardy here, the red (*Quercus rubra*), the white (*Q. alba*) and the bur-oak (*Q. macrocarpa*). It is also probable that the various birches and the mountain ash (*Pirus sambucifolia* and *P. Aucuparia*) can be made grow without difficulty, although they are better adapted to the other regions of the state. The evergreens are unlikely to do well here without careful attention, although the red cedar (*Juniperus scopulorum*), the scrub pine (*Pinus scopulorum*) and the white pine (*P. fragilis*), occurring native over part of this region, are the most promising. The small trailing juniper (*J. Sabina procumbens*) has also been successfully transplanted and makes a beautiful ornament for the yard.

This section is particularly adapted to the various ornamental vines for covering porches, houses, etc. The hop is everywhere planted, as is the wild cucumber (*Echinocystis lobata*), while the Virginia creeper (*Ampelopsis quinquefolia*), the wild clematis (*Clematis ligusticifolia*), the Canary bird flower (*Tropæolum peregrinum*), the morning glory and the sweet pea are frequently found. The beautiful large-flowered species of imported clematis seem also to grow without special protection, while nearly all the eastern annual vines and flowers will do well in these lower valleys wherever sufficient water for lawn irrigation can be secured.

2. MOUNTAIN VALLEYS (east of the Divide, mainly), including the Gallatin, Madison, Jefferson, Beaverhead, Upper Missouri, Deer Lodge and others between 3,000 and 5,000 feet elevation.

The usual shade trees here are the Balm of Gilead, the lance-leaved and the narrow-leaved cottonwoods—all native, as is also the quaking-asp, frequently found. The river cottonwood and the Carolina poplar are grown under favorable conditions, but are not well adapted to this altitude. The maples all winter-kill, except the native shrub maple (*Acer glabrum*) of the mountains and the oaks

### REMEDIES.

Should this insect become so abundant as to be injurious it may be held in check by treatment in the winter in the following manner:

Scrape off the loose outer bark, and wash the trunks and larger limbs with whale-oil soap solution, one pound in one gallon of water.

Many of the specimens brought to the office were found to have been killed by parasites.

## AN ANT AS A FRUIT PEST.

During the writer's frequent visits in the Bitter Root valley a number of complaints reached him concerning a small ant that builds its colonial mounds about the trunks of the apple trees and girdles them. Many colonies were found in the one orchard examined that were not at the bases of the trees but the ants showed preference for this position. Trees in these mounds were either killed or greatly injured as a result of the girdling of the stem. Inquiry made at different places in the valley showed that the trouble is a common one.

### REMEDY.

The use of the bi-sulphide of carbon, pouring it into the openings of the mounds and later closing the openings with earth, would probably be a satisfactory remedy.

The writer has had good success with this substance used against ants in the lawn and in other species but has never used it against this ant.

The substance is very inflammable, a lighted cigar being enough to ignite it. The confined vapor is explosive. Care should therefore be exercised with its use.

In treating lawn ants we have set fire to the vapor as it escapes from the openings, and have made the destruction of the ants more thorough. It would be well to experiment with this method also in the control of this ant, to see if any injury will result to the tree.

Only a small amount of the bi-sulphide of carbon is necessary.

# HORTICULTURAL DEPARTMENT.

R. W. FISHER, Assistant Horticulturist.

The work in this department for the year ending November 30 has been along the following lines:

A study has been made of the cultivated trees in this vicinity for the purpose of finding ornamental shade trees to replace the poplar or the cottonwood. Several trees new to this section have been introduced and are now growing in the Station nursery. The work already instituted of testing fruit trees for their hardiness has been carried on, and the quality and quantity of the different varieties of apples has been noted.

Variety tests of the common garden vegetables were made with the intention of finding those best adapted to our conditions, and the different varieties of small fruits were compared as to yield, quality of fruit and hardiness.

## FOREST AND ORNAMENTAL TREES.

It is a lamentable fact that with the very large timbered area we have in this state, so few trees are to be found outside the natural forest belts, which for the most part are wholly within the mountain ranges and therefore afford but little immediate benfit to the larger class of citizens who spend most of their time on the farms or in the cities.

Believing that the planting of ornamental trees should be given more attention than in the past this department has attempted to introduce the trees usually grown in the states, whose climatic conditions are somewhat similar to ours; and accordingly last spring several different varieties including oaks, elms, maples, linden, etc., were set out in the Station nursery with the intention of testing them for their hardiness and general adaptability to our soil and climate. This experiment will necessarily have to extend over a period of several years, as it is impossible to tell from one year's growth whether or not a tree is worthy of being generally planted.

In many cases when trees are imported into the state from lower altitudes and milder climates they are not perfectly hardy, whereas if they were grown from seed here they would in all probability prove hardy enough to stand our winters without injury. In order to test this thoroughly, tree seeds are being collected and will be planted as soon as practicable.

I find a record of there having been planted in 1895 a number of different trees, and it is thought fitting that mention be made of them in this place as they show some interesting facts in regard to the hardiness and general adaptability of certain trees to our climate and soil.

The following table gives in detail the data gathered concerning these trees. All the deciduous trees set in 1895 were seedlings, one year old, about twelve inches high; The conifers were two and three years old and from six to twelve inches in height.

| Common Name. | Scientific Name. | Time Set. | Height | |
|---|---|---|---|---|
| European Alder | Alnus glutinosa | 1895 | .... | Kills back each winter |
| Mountain Ash | Pyrus aucuparia | 1895 | 11.5 | Very hardy; fine tree for specimen planting |
| Silver Maple | Acer dasycarpum | 1895 | 10.4 | Not perfectly hardy; branches easily broken by wind |
| European White Birch | Betula alba | 1895 | 17 | Fine tree; very graceful and rapid grower |
| American Elm | Ulmus americana | 1895 | 11.5 | Very good tree; shows no signs of winter killing |
| Catalpa | Catalpa speciosa | 1895 | .... | All dead; not hardy in this climate |
| White Ash | Fraxinus americana | 1895 | 9.6 | Good trees; perfectly hardy |
| Green Ash | Fraxinus viridis | 1895 | 9.9 | Hardy |
| Bur Oak | Quercus macrocarpa | 1895 | 7.7 | Hardy; slow growth but will make good trees |
| Black Walnut | Juglans nigra | .... | .... | Seedlings. Not hardy; foliage killed by summer frost |
| European Larch | Larix Europea | 1895 | 12 | Hardy |

## EVERGREENS.

| Common Name. | Scientific Name. | Time Set. | Height | |
|---|---|---|---|---|
| Colorado Blue Spruce | Picea pungens | 1895 | 5 4 | Hardy; beautiful trees |
| Scotch Pine | Pinus sylvestris | 1895 | ... | All have died |
| Douglas Spruce | Pseudotsuga taxifolia | 1895 | 7 | Hardy; comparatively rapid grower |
| Red Pine | Pinus resinosa | 1895 | ... | All have died |
| Mountain Pine | Pinus montana pumila | 1895 | 4.5 | Hardy; rather slow grower |
| White Spruce | Picea alba | 1895 | 8.6 | Hardy; good trees, fast grower |
| Red Cedar | Juniperus virginiana | 1895 | 4,5 | Hardy; desirable for hedges |
| Norway Spruce | Picea excelsa | 1895 | ... | All have died |
| White Pine | Pinus strobus | 1899 | 1.8 | Apparently hardy; slow growth |
| Austrian Pine | Pinus Larico Austrica | 1899 | 2.5 | Hardy |
| White Fir | Abies concolor | 1895 | 5.2 | Hardy; very pretty tree |
| Arborvitæ | Thuja occidentalis | 1895 | 4 | Hardy; good hedge plant |

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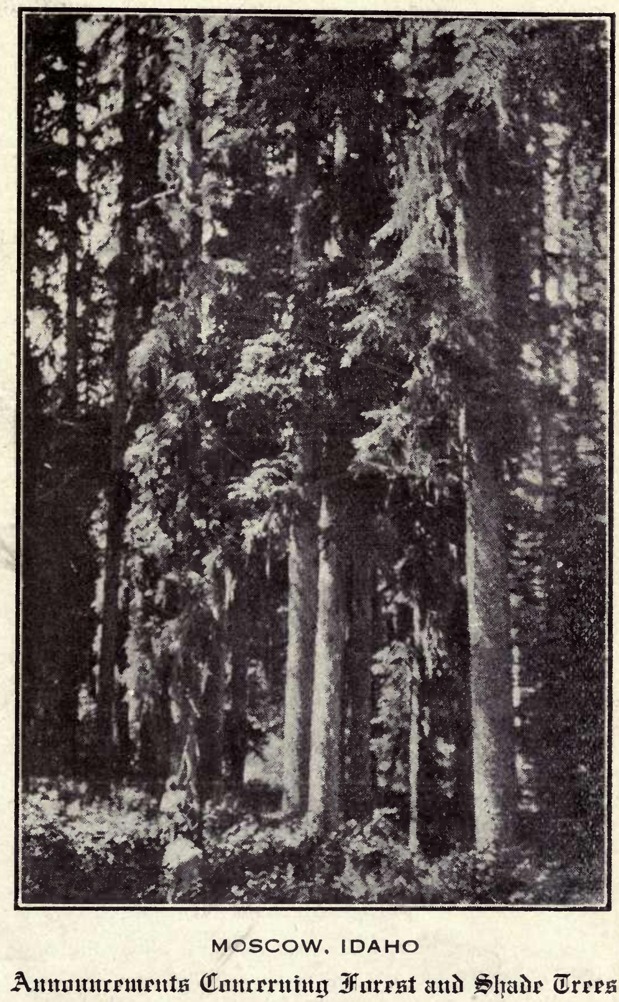
VOL. IX UNIVERSITY OF IDAHO BULLETIN No. 1

# THE UNIVERSITY OF IDAHO

# Department of Forestry



MOSCOW, IDAHO

## Announcements Concerning Forest and Shade Trees Recommended for Planting in Idaho

JANUARY, 1914

Published Quarterly by the University of Idaho, Moscow, Idaho, January, 1914.
Entered as second class matter at the postoffice at Moscow, Idaho.

The following trees are recommended for various planting purposes in Idaho:

### Black Locust

*(Robinia pseudacacia)*

A hard wood, valuable for shade, for posts, fuel, or any purpose, where strong hard wood is needed. This tree may be planted in almost any part of the state below an elevation of 4000 feet with success. Will grow without irrigation where fifteen inches of rainfall occurs, and will also respond wonderfully well to irrigation. Water should be turned off about the first of August in order to permit the wood to harden up before hard freezes come on. It may be grown in thickets for wind-breaks, poles, and posts, or spaced for shade trees.

### Honey Locust

*(Gleditsia triacanthos)*

A valuable hard wood tree, hardy below 4000 feet elevation, and doing well under irrigation or with twenty or more inches of rainfall. Excellent for posts and for other uses in contact with the soil.

### Norway Maple

*(Acer platinoides)*

A handsome shade tree. Will do well with twenty inches of rainfall or will grow rapidly under irrigation and is generally frost-hardy. Water should be turned off about the middle of August.

### Silver Maple

*(Acer saccharinum)*

A standard shade tree growing more rapidly but under much the same conditions as the Norway maple.

### Sycamore Maple

*(Acer pseudo-platanus)*

An excellent tree for the moister parts of the state. Will probably do well under irrigation. Hardy under 4000 feet elevation.

### Black Walnut

*(Juglans nigra)*

Valuable as shade and nut trees and also for posts. May be grown with 20 inches of rainfall or by means of irrigation. Water should be turned off about the first of August. Does not mature nuts well at the higher elevations.

### Butternut

*(Juglans cinera)*

Valuable for shade, nuts, or posts. Requires about the same conditions as the black walnut.

### White Ash

*(Fraxinus americana)*

An excellent hardwood tree for shade, posts, poles, or fuel. Wood valuable where strength and elasticity are required. Tree hardy up to elevations of 4500 feet, but requires good soil and plenty of moisture.

### Red Oak

*(Quercus rubra)*

Highly ornamented in spring and autumn. Hardy in all parts of Idaho. Requires good soil and plenty of moisture.

### Purple Willow Cuttings

*(Salix americana var. purpurea)*

Require abundant moisture. Will grow from three to six feet per year. Make excellent windbreaks for orchards, buildings, or stock. Hardy in all parts of Idaho.

### American Willow Cuttings

*(Salix americana)*

Will grow from two to four feet per year in good soil with plenty of moisture. Make good windbreaks for orchards, buildings, or stock. Hardy in all parts of Idaho. *Willows must not be set close to ditches,* as the roots are apt to choke them up.

### Austrian Pine

*(Pinus austriaca)*

Valuable as an ornamental tree or as a windbreak; rapid-growing and hardy any place in the state. Will thrive with twenty inches or more of rainfall or under irrigation.

### Jack Pine

*(Pinus divaricata)*

We recommend this pine as better adapted to the dryer parts of southern Idaho than any other. It will grow on very sandy soil and make very rapid growth on good soil. It has not been tried under irrigation but we are led to believe that it will make a strong growth. It is frost-hardy at Moscow, and will probably do well in all parts of the state at elevations below 4500 feet and where the rainfall is fifteen inches or more.

### Scotch Pine

*(Pinus sylvestris)*

This is a very hardy pine and has been thoroly tried out in Moscow. It has done well at various points in the state and we recommend it as suited to any elevation where rainfall is 15 inches or more or under irrigation.

### Douglas or Red Fir

*(Pseudotsuga taxifolia)*

We are growing both the coast and the Rocky Mountain varieties of this tree. We recommend both for the northern part of the state, but only the Rocky Mountain variety for the drier portions of southern Idaho. This variety will grow at any elevation and will respond vigorously to irrigation. A valuable tree for parks, windbreaks, and woodlots.

*Caution:* In transplanting any evergreens great care must be taken to keep the roots *always moist.* A few minutes in the sunshine will so harden the pitch in the roots that the trees are very apt to die. In transplanting, all trees should be placed from one to two inches deeper than they originally grew, the hole should be made large, roots spread well, and the earth packed *firmly.* If the soil is dry the use of a moderate amount of water, while filling the lower part of the hole, is recommended. No pruning is necessary.

The Department of Forestry has several thousand seedling trees as listed above for distribution to *residents* of *Idaho* at two cents each plus cost of packing. For each hundred trees, or fraction thereof ordered add twenty-five cents for packing and drayage. *Money must accompany orders.*

Maximum number of each species that may be sent in 1914 to each person is stated in the list below, and not more than a total of two hundred trees in all may be sent to one person.

| | | |
|---|---|---|
| Black Locust | 24 to 48 inches | 150 |
| Honey Locust | 8 to 18 inches | 25 |
| Norway maple | 6 to 20 inches | 10 |
| Silver maple | 6 to 20 inches | 50 |
| Sycamore maple | 6 to 20 inches | 15 |
| Black walnut | 8 to 20 inches | 10 |
| Butternut | 6 to 14 inches | 10 |
| White ash | 4 to 12 inches | 100 |
| Red oak | 4 to 10 inches | 5 |
| Austraian pine | 4 to 6 inches | 25 |
| Scotch pine | 5 to 12 inches | 50 |
| Jack pine | 4 to 14 inches | 20 |
| Norway spruce | 4 to 12 inches | 25 |
| Douglas fir (coast) | 6 to 18 inches | 20 |
| Douglas fir (Rocky Mountain) | 4 to 6 inches | 20 |

A limited number of *transplants* at four cents each may be had as follows:

| | | |
|---|---|---|
| White ash | 10 to 40 inches | 20 |
| Red oak | 10 to 36 inches | 10 |
| Scotch pine | 6 to 20 inches | 15 |
| Norway spruce | 5 to 18 inches | 15 |

Willow cuttings will be furnished at one-half cent each, packing and drayage extra 15 cents per hundred, maximum order to one person in 1914, 300, in addition to the 200 trees listed above.

*Be sure to give your express office* as trees must be so shipped.

We also have a limited number of the following trees which are giving promise of doing well in the state. Orders for these will be filled while the supply lasts at two cents each, after which we will substitute from the foregoing list as directed or use our own judgment in the absence of such directions.

| | | |
|---|---|---|
| European Larch | 6 to 18 inches | 5 |
| Japanese Larch | 5 to 16 inches | 5 |
| Blue spruce | 4 to 8 inches | 1 |
| Engelmann spruce | 4 to 12 inches | 5 |
| Pitch pine | 4 to 8 inches | 5 |
| Catalpa | 4 to 12 inches | 10 |
| Elm | 12 to 30 inches | 10 |
| Tree of heaven | 10 to 15 inches | 5 |
| Tulip | 4 to 8 inches | 5 |

All the trees offered are in a healthy and vigorous condition and will bear an inspection tag on leaving our nursery.

Address all orders to

C. H. SHATTUCK,
Department of Forestry,
Moscow, Idaho.

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Bulletin No. 27. March 1901.

Walter Mulford

## University of Idaho

# Agricultural Experiment Station

## Department of Botany.

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# MUSHROOMS OR TOADSTOOLS:

## A Natural Food Product.

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By L. F. HENDERSON.

NORTH IDAHO STAR PRESS

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# BULLETINS.

The regular bulletins of the Station are sent free to all who request them. Some bulletins issued lately are:

21. The Codlin Moth.
22. Onion Growing.
23. Meteorological Records and Prediction of Frosts.
24. Cattle Feeding and Crop Tests.
25. The Composition of Arsenical Insecticides.
26. (1) Crude Petroleum, (2) The Elm Louse, (3) The Pear Leaf Blister Mite.

# MUSHROOMS OR TOADSTOOLS:

## A NATURAL FOOD PRODUCT.

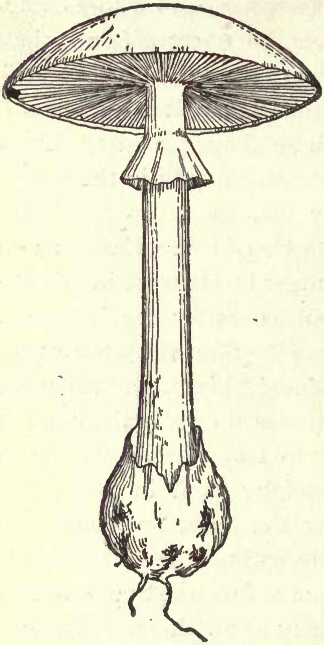
BY L. F. HENDERSON.

## I.

Mushrooms or Toadstools in their various forms are natural food products laid at our very doors by a bountiful nature, and yet they are generally overlooked, or if observed are in the main avoided with a shudder. It will be the object of this bulletin to acquaint the people of our State with the common species, to show that the majority of them are not only *not* injurious but of great culinary value, to give a brief sketch of their growth, their kinds, the methods to be used in their collecting and in preparing them for the cook, and lastly a few recipes showing the best ways to prepare them for the table.

The ignorance which prevails in this country in respect to mushrooms is much greater than in most of the states of Europe, and even in some of the parts of Asia, notablv Japan and China. In these various countries the population is so much denser the number of the poor is so much larger, and the cultivable land is so restricted in comparison with the numbers concerned, that more attention to these natural products of the soil has been given, or even forced upon them, with the result that mushrooms are collected in immense quantities and varieties, and are dried for home consumption or offered in the markets as regularly as are the common vegetables. In many provinces in Europe persons are appointed, whose duty it is to inspect the mushrooms collected and brought into market, to see that no poisonous kinds are introduced by mistake, and to give general information concerning the kinds, both poisonous and edible. In this way dozens of not only harmless but nutritious kinds are exposed for sale, the people generally become acquainted with them, fine foods or at least agreeable condiments are added to the common bills of fare at small prices, while many poor persons partly or wholly support themselves in gathering them for market. So highly are various species of mushrooms appreciated by the Japanese and Chinese of the Pacific coast, and so little are our native kinds understood, that tons upon tons are brought into San Francisco annually in a fresh or in a dry state for consumption by these people alone. Specimens of the celebrated Japanese varieties, the Shiitake, a species of Lepiota, and the Matsudake were recently sent to our institution by a Japanese gentleman, arriving here in a nearly fresh condition, and we were assured by the donor that they were a regular article of food upon his table. In nearly any of the forests of the Northwest tons upon tons of valuable and nutritious mushrooms go to waste annually, either totally unobserved or avoided with distrust by the observant under the impression that they are "toadstools" and consequently poisonous. Many a prospector, surveyor or hunter in our vast and unpopulated districts has gone hungry,—nay, it may be, has died from hunger,—with food in great quantities and of varying degrees of nutritiousness and excellence going to waste about him! The too common expression, that "toadstools are dangerous things, that people don't know anything about them, and that the safest way is to let them alone," is too foolish for utterance, and would not need to be mentioned in this connection did not this opinion receive the sanction of otherwise sensible and even educated persons. With just as much reason can you say that beans cannot be told from peas, cabbages from turnips. A child of ten years ot age, with common powers of observation, to say nothing of adults, can be told in a few hours how to distinguish at least a dozen species of edible mushrooms, and, when poisonous species exist whose look closely resembles that of harmless species and whose confusion might lead to serious consequences, to reject *all* suspicious kinds. It is not necessary for mushroom lovers to know scientifically *all* the many kinds in their neighborhood; it is sufficient if they know a dozen or two, for from these they can select kinds that are accessible and available almost every month in the season from early spring to late fall. Luckily too, the poisonous kinds are not nearly so common on our coast as in the Eastern and Southern states, and therefore less danger is incurred in mistaking different species, especially the poisonous for the harmless. Not a single really poisonous species has been found by the writer in the state of Idaho up to this date. Yet for this reason we should not be too sanguine that poisonous species do *not* exist here; it should rather put us on our guard to avoid any accidents due to fancied security. This should be carefully kept in mind, that mushrooms, or toadstools if you prefer the term, are constantly succeeding one another throughout the spring, summer and fall. The same locality therefore that may have furnished only harmless forms at one time of the year, may a month later produce poisonous or at least disagreeable and harmful kinds. So the only safe way of avoiding danger is *to know your plants collected*, if they are to be cooked, or to find out what they are from some one competent to inform you if you do not know them and wish to try some or all on the table.

And right here it might be pertinent to express the wonder that more persons are not killed annually than are, on account of the careless way mushrooms are sometimes gathered, the good with the bad, or on account of the carelessness with which different species, somewhat resembling one another, are collected and no care given their identification. I know of one gentleman who laughingly stated that when he drove out into the country after mushrooms, he collected generally all that were tender, *and ate them all*, so convinced was he that no poisonous kinds exist in the region from Spokane to Lewiston. Mr. F. V. Coville, Botanist of the Department of Agriculture, mentions in his "Observations on recent cases of Mushroom Poisoning in the District of Columbia" a case, where a lady walking the streets of Washington one day "met a family, consisting of a man, woman, and two children, who had just completed the gathering of a basketful of the fly amanity and the death cup, which they were taking home to eat." These are two of the most poisonous kinds that are to be found, and these people had evidently mistaken them for harmless species. Yearly our papers in different parts of the country are called upon to record sad and terrible deaths through mushroom-poisoning, due in great measure to absolute carelessness in separating the harmless from the harmful kinds, or to careless experimentation with species known to be harmful.



Death cup, *Amanita phalloides*. Poisonous. Two-thirds natural size. F. V. Coville, Circular No. 13, U. S. Department of Agriculture, Division of Botany, "Observations on Recent Cases of Mushroom Poisoning in the District of Columbia."

## What is a Mushroom and What a Toadstool?

Right here it might be useful to answer that oft-repeated question "How am I to know a Mushroom from a Toadstool?" In answer let it be distinctly understood that there is no difference between a toadstool and a mushroom; all mushrooms are toad-

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PLATE 1. The Common Mushroom, *Agaricus campester*, springing up spontaneously in a hot-house rose-bed. One-third life size. The mycelium, or "spawn", was unconsciously introduced with manure.

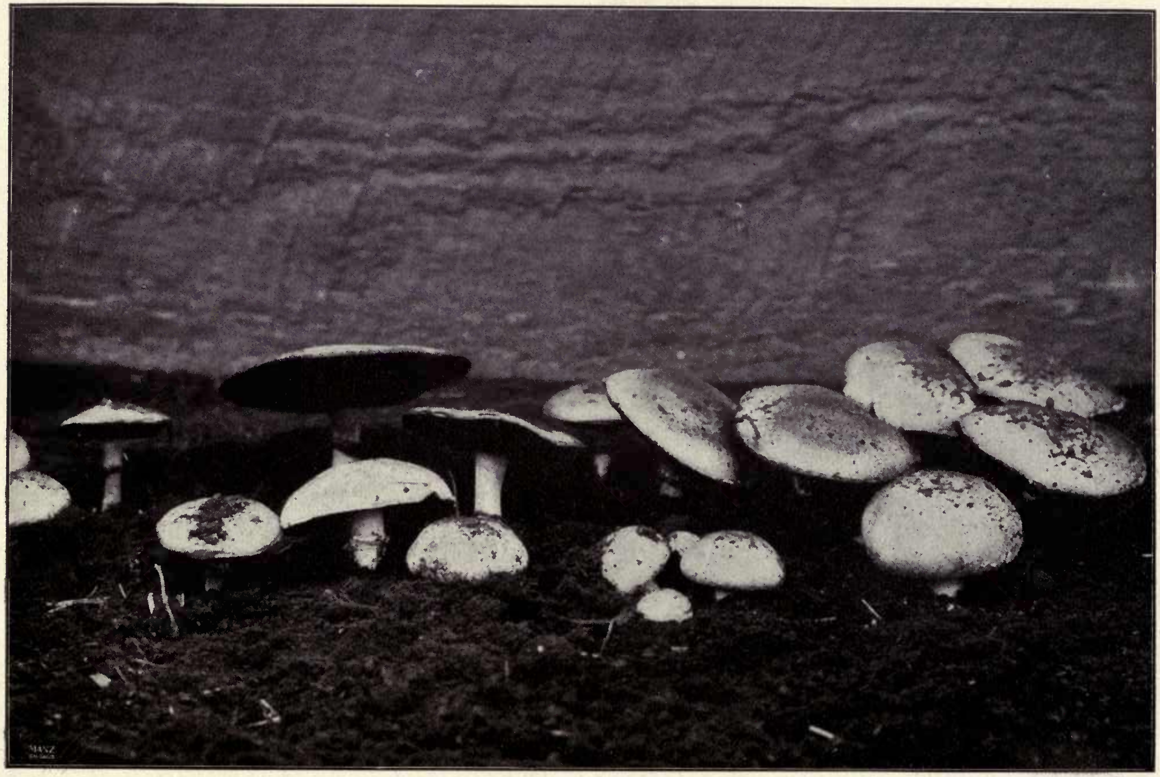

Fig. 1

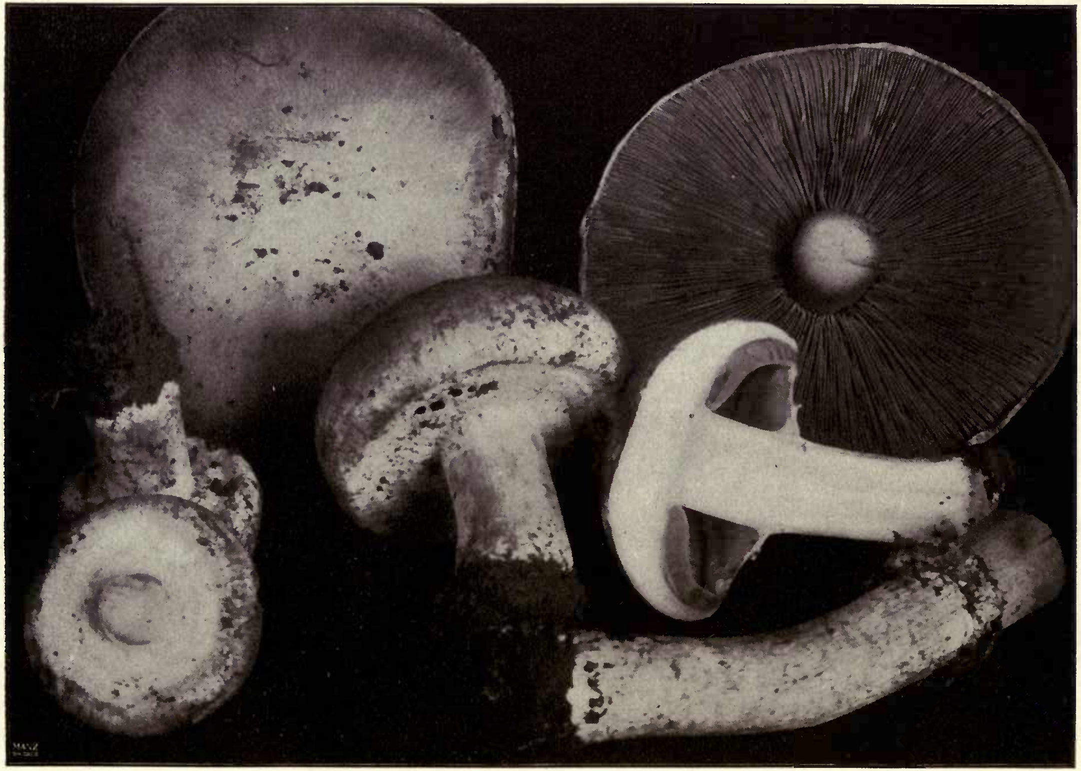

Fig. 2

stools and all toadstools mushrooms, according to which name you prefer. Many people limit the name mushroom to the common Field Mushroom, *Agaricus campester*, and consider all others, not possessing the "pink gills" of this species, toadstools. This is too limited and even misleading a use of the term, for many of the mushrooms used in different countries, and sold in the market as such, do not belong to the same genus or even family to which the Field Mushroom belongs. A few of the tests, supposed to distinguish the poisonous from the non-poisonous kinds, and therefore a mushroom from a toadstool supposably, will be given here, while it will be distinctly stated that not one of these supposed tests is of any value, relied upon alone. Such are: 1.—Eat only mushrooms grown in open ground, never one in the woods. 2.—Eat no mushroom whose gills are not pink. 3.—Eat no mushroom that will discolor a silver spoon. 4.—Eat no mushroom which is white all through or that will exude milk when cut. If we should obey the first injunction, we would be cut off from nearly all the Boleti, the Morells, the Cortinarii, the Pleuroti, and a host of others. If the second we would be limited to the Field mushroom and a very few others, and lose all those delicious kinds whose gills are red, yellow, white, or with even shades of blue and green. If the third we would lose the gastronomic pleasures of many harmless kinds, some of which do, some do not,change or darken silver. If the fourth, we would be cut off from the yellow or red Boleti, the white Hygrophori, or the red or yellow Cortinarii, as well as from a number of the delicious milk-giving Lactarii. In fact the usually safe rule "Avoid all mushrooms or toadstools with a *cup* at the base of the

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PLATE 2. The Common Mushroom, *Agaricus campester*, often known as "Pink-Gills." Slightly reduced. Two of the specimens are expanded and past their prime for food. One specimen is split through the middle, in order to show the "veil" still attached to "cap" and "stem". The absence of any volva, or "cup", at the base of the stem is noticeable, thus affording a good character by which to separate this genus from the Poisonous Amanita, often mistaken for one another.

stem," though an excellent rule in the main, is not to be relied on implicitly, as the beautiful *Amanita Caesarea*, whose base has a very perfect cup, has been the theme of epicures from the time of the Greeks and Romans. Yet as this *cup* is the badge of the genus Amanita, with a few closely related, and as this genus of plants includes most of the poisonous ones in the United States, it is best to avoid them all. I shall probably be pardoned quoting here a more exact rule as given in Charles McIlvaine's excellent work on "One Thousand American Fungi, Poisonous and Edible," though somewhat lengthy, for by its strict observance nearly all the poisonous kinds can be avoided. "Any toadstool with white or lemon-yellow gills, casting white spores when laid, gills down, upon a sheet of paper, having remnants of a fugitive skin in the shape of scabs or warts upon the upper surface of its cap, with a veil or ring, or remnants or stains of one, having at the base of its stem—in the ground—a loose skin like sheath surrounding it, or remnants of one, should never be eaten until the collector is thoroughly conversant with the technicalities of every such species, or has been taught by one whose authority is well known, that it is a harmless species." Luckily, as before mentioned, Amanitas exist, if they exist at all, but rarely on our Northwest coast, none having been seen by the writer in Idaho. Even should they not exist here, care must be taken in eating mushrooms without sufficient trial *by each collector*, as nowhere is the old adage truer than with these plants, "What is one man's meat is another man's poison." Even should none of our species prove absolutely poisonous, many of them are intensely disagreeable as well as inedible, and their eating, even if they were not repellant to the appetite, would be followed by indigestion and bowel complaint, if by nothing worse. People are to be met with quite often upon whom strawberries and eggs act as poisons, and even butter is sickening and causes nausea to some. An acquaintance of the writer is rendered sick whenever he eats liberally of the common mushroom, Agaricus campester. Therefore the best rules to be followed, for any one pretty well acquainted with the study of mushrooms but unacquainted with their *taste*, and especially for the novice in either capacity, are these:—If you know a mushroom, and one which by common report is harmless and edible, eat of it sparingly, till you find out by *personal experience* that it does not disagree with you. If you wish to test species entirely unknown to you, first cut out a small piece of the solid meat, using special precautions to see that it is not invaded by the larvæ of insects, and chew it up, not swallowing the fragment or its juice. If it has a very bitter taste, discard it at once. If it has a peppery or acrid taste, be equally careful, or swallow a little of the juice to mark its effect. This is well, as many of the best species when cooked lose the acrid or peppery taste of the raw plant. On the other hand, most of the harmful species, excepting some of the Amanitas, have at first a disagreeable, acrid or peppery taste; so one should exercise the utmost care where any of these tastes are present. When, on the other hand, the plant has a good smell and a taste like raw meal, or perfumed like fruits of various kinds, or not objectionable in any way, it may be reasoned that it is probably not harmful, and a little of the juice may be swallowed. If it is found after the lapse of an hour or two that it has not harmed you, try a larger piece. Mr. McIlvaine, the gentleman above quoted and who has experimented with and eaten more toadstools than probably any other person in the United States, says, "But many species, delicious when cooked, are not inviting raw. Cook a small piece, do not season it. Taste again; if agreeable eat it (unless it is an Amanita). After several hours, no unpleasant effect arising, cook a larger piece, and increase the quantity till fully satisfied as to its qualities. Never vary this system, no matter how much tempted. No possible danger can arise from adhering firmly to it." Some of the commonest ways of cooking mushrooms will be given at the end of this bulletin.

## Where Do Mushrooms Grow?

The answer is brief—wherever other plants grow. Some genera delight in the open fields, some in moist dense woods, some on old stumps and logs, some on railroad embankments, while some plebeian but delicious species grow on manure piles and rotten straw. Of the species specially discussed in this paper, the field Agaric or mushroom loves the grassy pasture, especially when browsed by cattle and enriched by their droppings; the two species of Coprinus cling, at least in Idaho, almost exclusively to railroad cuts and embankments, or to places where engines stand considerably and cinders are thrown out; the Ivory Hygrophorus and other species of this genus like pine and fir woods; the Hypholomas are found about rotten stumps and logs; the Boleti like thick fir forests, pine woods, or even open hills near woods; the Hedge-hog mushrooms surprise us as they almost light up the dark forests when standing erect upon or hanging down from fallen logs; the Puff-balls love open ground and are commonly associated with the field Agaric; the Morels seek retirement in woods or in copses along our hills. The mushroom is a rapid grower and both needs and contains much water. We may therefore conclude by saying that dry, rocky, or sandy places are about the only ones which do not produce mushrooms, while they flourish best in cool, moist woods and along creeks and rivers.

Besides their appeal to the palate, these interesting plants have much attraction for the one who collects them merely for study, on account of their strange and beautiful forms. Though many dress themselves in the veriest quaker drabs and grays, they all repay study with the microscope; while many of them are as beautiful in their colors and as variable and exquisite in their forms as the finest flowers. Every shade of color is represented in fungus or its spores; every shape of umbrella, cap, vase, globe, bush, tree, or map is faithfully portrayed in miniature; every smell

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PLATE 3. The Shaggy-Mane Mushroom, *Coprinus comatus*, at the proper stage for food. Slightly reduced. Later the stem elongates, the loose "ring" drops to the ground, and the cap "deliquesces", that is melts into a fluid black as ink from the black spores. Of fine flavor, but stronger than the last.

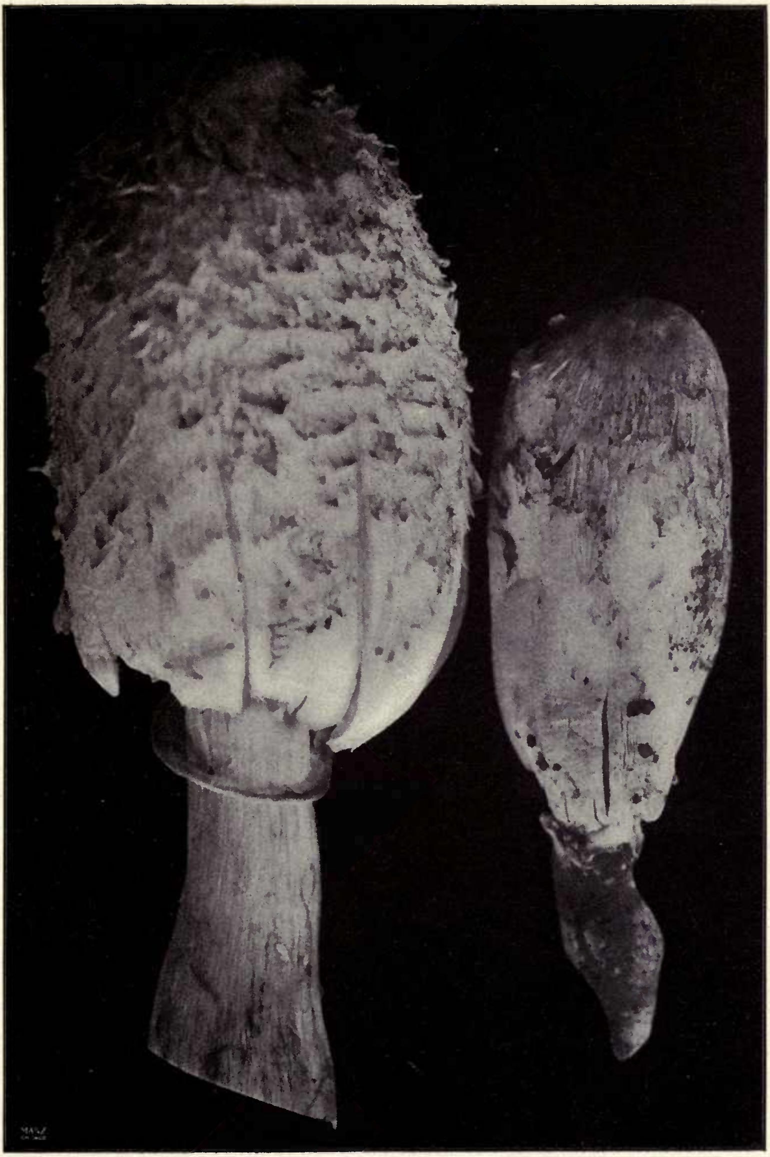

Fig. 3

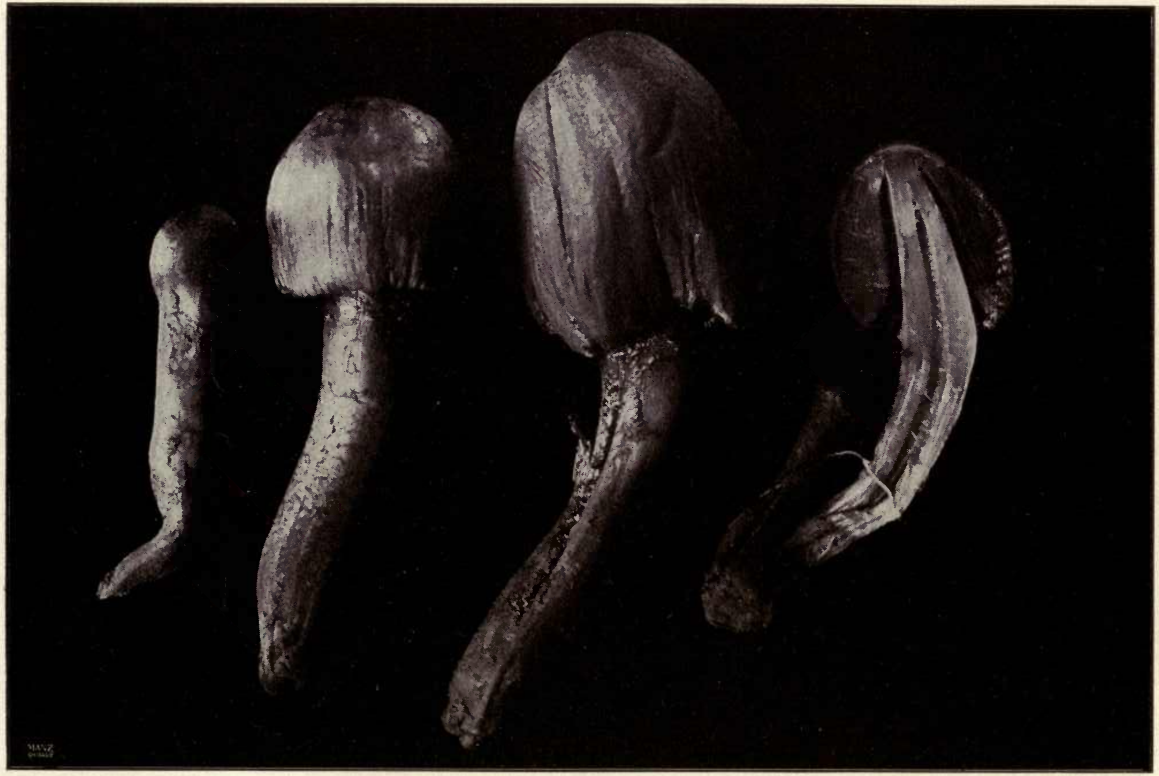

Fig. 4

from the exquisite apricot of Cantharellus to the disgusting nightmare of the Stinkhorn; every taste from that of ripe fruit and fresh meat to rotten wood, quinine, and things even more disagreeable or even disgusting, finds a representation in these fungi, leaving out of consideration the various things they mimic when cooked, such as meats, oysters, clams, steaks and numerous vegetables. Like the different flowers, they tell of grassy meadows, of thick shady woods, of mossy dells where the pheasant and the grouse speed from you on whirring wing, of old logs from under which the rabbit springs or on which the pine-squirrel sits and eats his meal from cones of fir and pine, of trickling rill or rushing river. It is strange that from the sins of a few of them such mingled feelings of horror and disgust arise in the average mind when you speak of "toadstools!" And yet it is none the less true that when any one has systematically hunted these much depreciated fungi for any length of time, whether as a student or as a "mycophagist" or mushroom eater, he has become much attached to them and their pursuit.

## How and What to Collect,

We will first suppose that one is going out to collect mushrooms for the table. First of all notice whether any of the specimens you dedesire to collect have distinct "rings". or collars on the stem. If they have, dig them up carefully, and notice whether there is a distinct "cup" at the base of the stem, even with or underneath the surface of the earth. If they have this cup together with the ring, discard all such, as you have collected Amanitas. It is not meant by this that *all* toadstools not having these marks are wholesome, for some species not Amanitas are known to be poisonous. The number of poisonous species, outside of the Amanitas are, however, so few, in spite of the general impression

PLATE 4. The Ink-Cap Mushroom, *Coprinus atramentarius*. One is cut open to show the separation of gills from stem. Slightly reduced.

to the contrary, that having eliminated this baneful but beautiful genus from our collecting, the greater part of the danger is eliminated at the same time. Having assured yourself that the plant is not an Amanita, see that it is free from larvae and that it is young and not past its prime. These two cautions are very important, as many mushrooms, sweet and nutritious when fresh, are bitter and nauseous when infested with larvae or when beginning to decay. It is even claimed by many that the deadly helvellic acid, found in the *Gyromytra esculenta*, is only developed when the plant is too old or inclining towards decay. Although this acid has been isolated from this species and several known cases of poisoning have been traced to it, yet this danger must be due to some unusual condition or incipient decay in the plant, for Mr. McIlvaine tells us that he and his friends have eaten of it again and again without experiencing the slightest discomfort from their daring. If the plant you are collecting is known to you as an edible species, these two cautions about larvae and too mature plants are the only ones to be noted. If however you are collecting toadstools about which you know nothing, you cannot proceed with too much caution. Test the plant by cutting off a portion of a fresh cap, and try it as before detailed for bitter, acrid, or peppery principles. If the piece has a pleasant taste and smell, a little of the juice can be swallowed, for even were the plant poisonous, a drop or two of the juice cannot injure you permanently. If by these tests it seems good for food, test the stem to see whether it is fleshy and brittle like the cap, or tough. Very few toadstools have the stem as fleshy as the cap, so that it is better to collect only the caps and thus save weight and dirt, unless the stem has been proved to be succulent and edible. If any of the stems are collected, the different plants should be wrapped in soft paper to prevent the dirt from getting into the gills or pores of the fungus. If you cannot refer these collections to someone who knows the main species in any district, and can pronounce upon their edibility with *certainty*, try them by the gradual cooking process previously detailed from

Mr. McIlvaine's book. Mushrooms should always be prepared for the table soon after collecting them. If, on the other hand, you are collecting for study as well as for the table, more care must be pursued in their gathering. With a stout knife or trowel lift up the plants from the soil entire, or cut them out of the log or tree. Make on a slip of paper careful notes about the specimen as soon as collected, for it is difficult for the most expert student to distinguish species without such notes and when the plants have dried up. These notes should distinctly state whether the toadstool grows on soil or on wood, and what kind; whether the top of the cap is viscid, smooth, hairy, or water-soaked; whether the gills are free from or attached to the stem; whether the stem is fleshy and breaks easily or bends like rubber without breaking, or if it breaks, snaps with a decided snap; what are the colors of cap, gills and stem. It is especially necessary to make these notes in the field, for within the few hours elapsing between time of collecting and time of analyzing many of these valuable characters will have disappeared, and even before the specimen is dry most of them will have vanished. When these notes have been made, wrap each plant carefully in oiled paper if it is sticky or slimy, or in thin wrapping-paper if it is not, putting in the same paper the notes you previously made. If any one not possessed of books or other means of studying these plants, and yet desirous of learning whether the plant is edible or not, (and let it here be kept in mind that most of the toadstools *are* edible,) will exercise care in these notes and in wrapping good thrifty plants carefully in the paper, these specimens can if at all solid be sent some distance by mail or express to any student of the group. If this is to be done, a little moist but not wet moss should be packed about the plants carefully and the whole sent in a cigar-box or in one of heavy cardboard. This Station will be willing and pleased to make such identifications for any who may wish to become acquainted with some of the edible species of toadstools and who will make the proper notes and exercise due care in packing and sending the specimens.

After the plants have been brought home, and you have collected too many species to determine them all before they will have wilted, and so lost some of their important diagnostic characters, make copious notes upon a slip of paper, and let this slip accompany the plants while they are drying. It is unnecessary to say that it is much more satisfactory to analyze your plants while they are fresh; but if this for any reason cannot be done, the copious notes are essential. Besides the notes, a very helpful as well as beautiful object is a "spore-print" of the mushroom. To make this, have ready thick paper or cardboard on which a very light coating of mucilage has been placed and allowed to dry. Cut off the "cap" of the mushroom and turn it with the gills or pores *downwards* upon the gummed paper. Set over the specimen a bell-jar, or failing this a large dish, to completely cut off any currents of air. After a certain period, varying from an hour or two to a day or more, according to the specimen you are dealing with, innumerable quantities of the spores will drop from the gills or pore-surfaces upon the paper, the water in the fungus sufficiently softening the mucilage, and will leave a perfect print of the plant used, the gills or walls of the pores leaving tracings upon the paper unmarked by any of the spores.

This is most necessary; for in the large and important family of Agaricaceæ the colors of the spores are among the most useful means of determining genera. Moreover, these various colors—white, yellow, rosy, purple, brown, and black—are entirely independent of the color of the gills or spore-bearing surfaces; while spores which, viewed *singly* under the microscope, may seem of one color, often prove when collected on a spore-print to be of quite another color. While the different spore-prints are making, providing careful notes have been taken, the specimens to be preserved must be dried out quickly, so as to kill the larvæ before the fungi are riddled by their canals, as well as to preserve the

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PLATE 5 The Ivory Hygrophorus, *Hygrophorus eburneus*. Slightly reduced. Very common in pine woods. A delicate and delicious mushroom. Known readily by its snowy whiteness and viscidity.

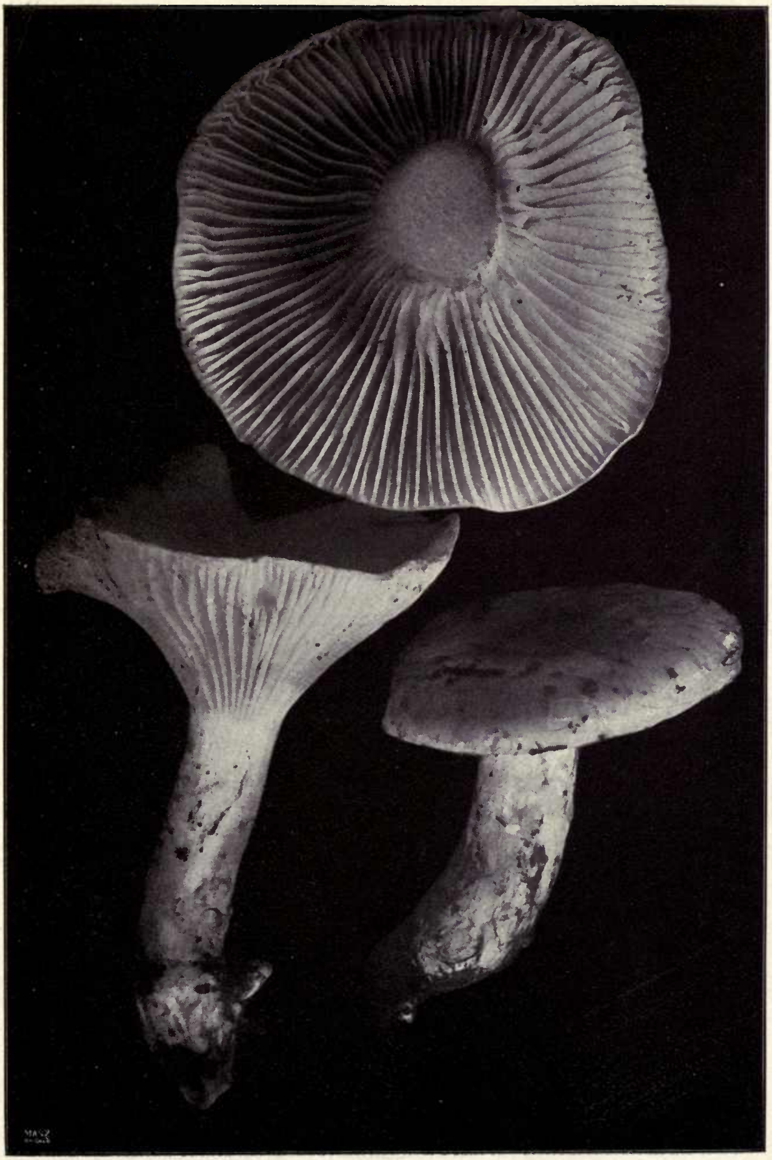

Fig. 5

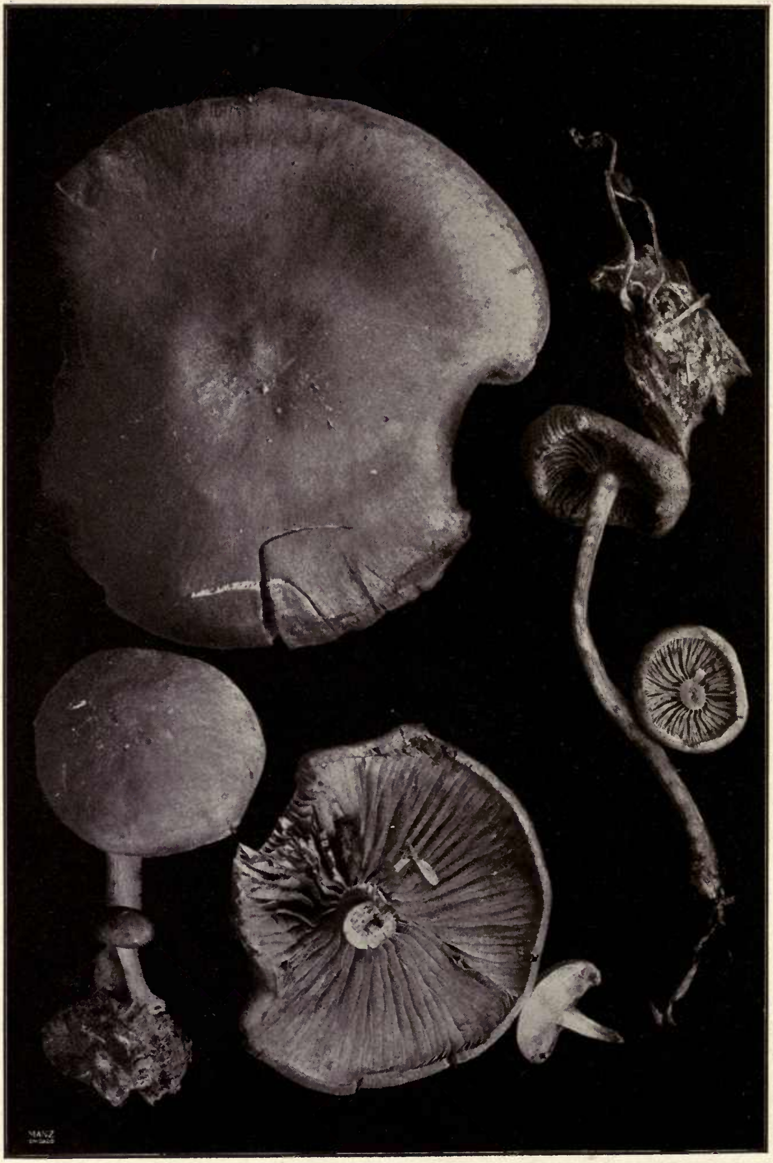

Fig. 6

colors and prevent decay. Professor G. F. Atkinson of Cornell University uses for this purpose a large oven made of tin perforated here and there with holes, and containing many metal frames also perforated, so as to allow free circulation of air while the plants are drying. This tin oven is raised upon legs, so as to allow a gas jet to be placed under the bottom of the oven and thus furnish a regular heat. By the proper regulation of this heat, by the perforations in the compartment-frames, and by care in occasionally turning the specimens, they can be dried out perfectly in the course of a few hours or a few days, depending upon the size and water content of the different species. Where these very perfect adjuncts cannot be had, the plants will dry quite well in direct, strong sunlight, or by placing them on metal frames built up around the stove-pipe at home. The heat in either case must be strong enough to kill the larvæ rapidly as well as preserve the colors, or the specimens will be but poor at best.

## Composition of Mushrooms.

There seems to be so much difference of opinion in regard to the value of mushrooms as foods, that a little time will be spent in quoting from those who have made studies upon these plants from the chemical side, as well as to mention the symptoms of and antidotes to mushroom poisoning given by chemists and physicians.

It seems from recent chemical analyses that too much credit has been given mushrooms as food plants. We can find in otherwise reliable scientific works the most extravagant statements about the nitrogen contents of these fungi, some giving it as high as 50 or 60 per cent of dry weight, and likening them to "beefsteak," "oysters," and other foods high in proteids. Perhaps the most

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PLATE 6. The Gray-gilled Hypholoma, *Hypholoma capnoides*. Slightly reduced. A very fine mushroom, good raw or cooked, but closely resembling and growing with the Bitter Fasicled Hypholoma, *Hypholoma fascicularis*.

authoritative and careful analyses of these plants ever undertaken in our country were made by L. B. Mendel of the Sheffield Laboratory of Physiological Chemistry at Yale University, and published in the American Journal Phys. I. 225-238. In this article Mr. Mendel draws comparisons between many kinds of foods such as beef, flour, beans, potatoes and cabbages, compared with several species of mushrooms He first goes on to show, that mushrooms, like most other vegetables, are composed largely of water, averaging between 70 and 92 per cent. He then shows that in the dry plants from 2 to 6 per cent of nitrogen is present, but that the mistake has been in thinking that on account of this high nitrogen content, all of it is of necessity *available nitrogen.* He shows the fallacy of this belief by proving that the proteid content, or the *food* nitrogen substance, is not higher than 3½ per cent. The fat extracts by ether he shows to be never higher than 6 per cent. Now comparing these with a few vegetables and meats, we can arrive at a better understanding of the food value of these fungi.

### Nutritive Value of Ten Pounds of the Several Foods.

| | PROTEIDS | FATS | CARBOHYDRATES | COST | CALORIES OR HEAT-GIVING UNITS FOR ONE CENT |
|---|---|---|---|---|---|
| Beef (round) | 1.87 | .88 | | $1 50 | 48 |
| Beans | 2.23 | .18 | 5.91 | .30 | 530 |
| Flour (rolled process. | 1.13 | .11 | 7 46 | .25 | 658 |
| Oysters | 61 | .14 | .33 | 2.00 | 11.7 |
| Potatoes | .18 | .01 | 1 53 | .10 | 325 |
| Cabbage | .18 | .03 | .49 | .15 | 93 |
| Coprinus comatus | .04 | .025 | .434 | 2.50 | 3 9 |
| Pleurotus ostreatus | .051 | .042 | .828 | 2 50 | 7.2 |
| Morchella esculenta | .094 | .05 | .306 | 2 50 | 3 8 |
| Agaricus campester | | .03 | .46 | 2.50 | 5.3 |

Assuming that these figures are correct, it is very evident that pound for pound, to say nothing of price, the mushrooms used do not compare with some of the commonest meats and vegetables in either of the following functions:

1. To form the material of the body and repair its wastes.
2. To supply energy for muscular exertion and for the maintenance of the body heat.

There is, however, according to Mr. Mendel and others, a very important office performed by mushrooms that cannot properly come under either of these two functions, and which cannot be measured by them, and that is *to act as relishes and helpers of digestion.* That this function of mushrooms is not to be slighted, is proved by the fact that these plants are welcomed on the tables of rich and poor alike, and that they have been proved by many years, nay centuries, of experience a very valuable adjunct to the bill of fare, when used alone or in connection with other foods to impart a relish. And this value, it may be remembered, is one which can be measured but poorly, if at all, by chemical analysis.

The second topic of this heading, the poisonous principles of certain mushrooms, will be touched upon, though in all cases of mushroom poisoning the best thing to do is to call in a good physician, where this is possible. The three worst principles or poisons obtained from mushrooms are Muscarine, Phallin and Helvellic Acid. Muscarine is the most dangerous alkaloid to be ound in mushrooms. It is found in several of the Amanitas, and in a few Boleti and Russulas. A dangerous dose for a man is merely .003 to .005 of a gram, equivalent .06 of a grain. The worst feature about poisoning from these alkaloids is that they are not at once evident, but only after a lapse of several hours. Vomiting and diarrhœa generally occur, with flow of saliva, giddiness, and derangement of vision. This is succeeded by stupor, cold sweats, and weak heart action. If the stupor lasts for one or two days, death ensues. The treatment for this poison consists in carrying off all unabsorbed fragments of the mushroom from the alimentary canal, and in strengthening the weak heart action.

For the first the strongest emetics should be used, such as tartarized antimony and apomorphine; and to bring about the desired heart action, hypodermic injections of atropine, according to many writers, in doses of $\frac{1}{180}$ to $\frac{1}{50}$ of a grain, until about $\frac{1}{20}$ of a grain has been used. In very violent cases, and where the patient has been long ill before aid has been summoned, even $\frac{1}{20}$ of a grain may be administered. "Freshly ignited charcoal or two grains of one per cent alkaline solution of permanganate of potash may be then administered, in order, in case the former or antimony emetic has been given to absorb the poison, or, in the case of the latter or apomorphine, to decompose it. This should be followed by oils and oleaginous purgatives, and the intestines should be cleaned and washed out with an enema of warm water and turpentine."

*Phallin* is a deadly poison, of uncertain chemical nature. Mr. Chestnut, of the Department of Agriculture, from whose Farmers' Bulletin on "Thirty Poisonous Plants" this description, as well as much under Muscarine, is taken, says, "A large number of cases of poisoning have been attributed to this fungus in ancient as well as in modern times. The symptoms are characteristic; no bad taste warns the victim, and usually the first effects do not appear until from nine to fourteen hours after eating. There is then considerable pain, and there may be cramps in the legs and other nervous phenomena, such as convulsions and even lockjaw. In a few cases there are spasms. The pulse is weak and either quick or slow in its action. The pupils of the eyes are sometimes dilated. The abdominal pain is rapidly followed by nausea, vomiting, and extreme diarrhœa, the discharges assuming the peculiar 'rice water' condition characteristic of cholera. The latter symp-

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PLATE 7. The Chestnut colored Boletus, *Boletus clintonianus*. Slightly reduced. From the lowest specimen the stem has been cut away to show its solid nature, while from the intermediate one part of the cap has been cut away to show its solid nature and the depth of the "pores." Part of the slimy "veil" can be seen forming an irregular "ring" on the upper part of the stem of the last specimen. Of good flavor.

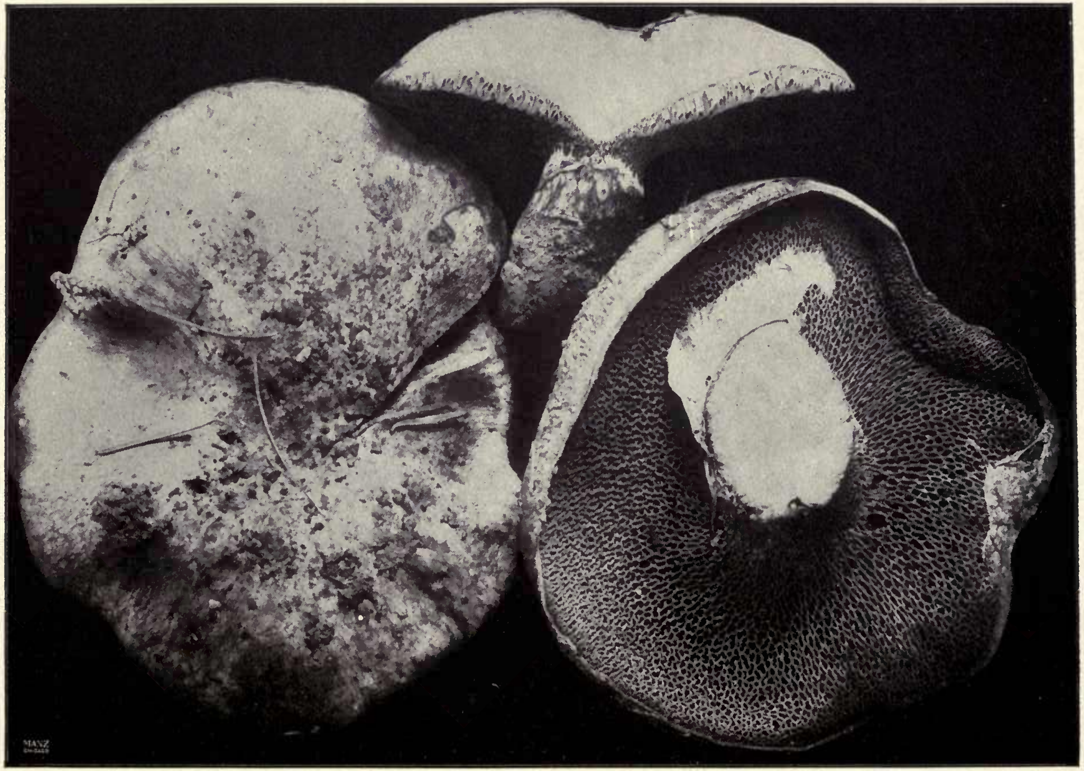

Fig. 7

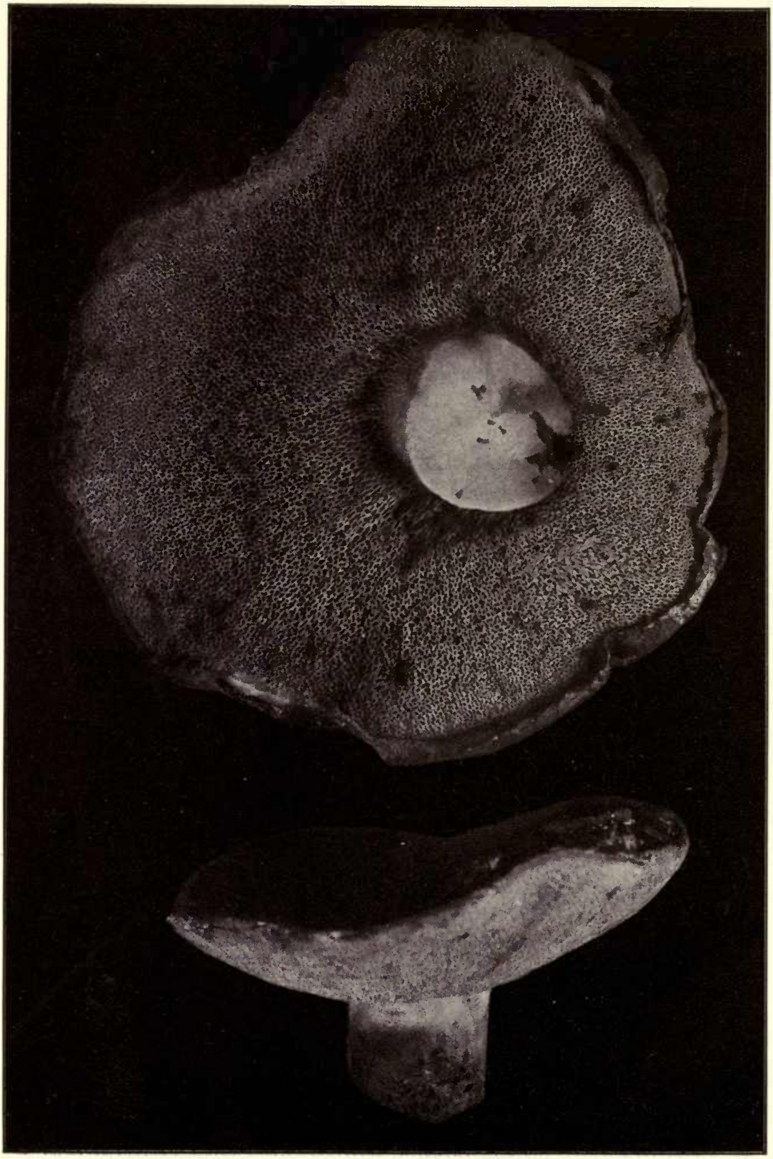

Fig. 8

toms are persistently maintained, generally without loss of consciousness, until death ensues, as it does in from two to four days." "There is no known antidote by which the effects of Phallin can be counteracted" (the blood corpuscles being quickly dissolved, and the blood serum quickly escaping from the blood vessels into the alimentary canal). "The undigested material, if not already vomited, should, however, be removed from the stomach and intestines by methods similar to those given for cases of poisoning by Amanita muscaria."

*Helvellic acid.* This deadly poison hss been extracted from a plant known as Helvella esculenta, Pers., or Gyromitra esculenta, Fr. There is no antidote known, and the action upon the blood corpuscles with the accompanying symptoms are similar to those of phallin poisoning. This poison has been found to be soluble in hot water, so if the plants are first soaked in hot water, and this thrown away, there is little danger in eating this fungus. As before remarked, fresh, young specimens seem to be free from this poison, as Mr. McIlvaine says he and his friends have eaten this plant with impunity.

It is a matter of interest that some of the fungi containing these poisons, and which are very poisonous in our country, are not dangerously so in others. The Amanita muscaria, containing the poison "Muscarine," is said to be used by the peoples of northern Russia to induce intoxication. It is likewise interesting that these poisonous plants may be cooked when they have been properly treated—a dangerous experiment at best. It is known that common salt is a solvent of phallin, and that vinegar is a remover of the poisonous muscarine. Mr. Coville, in the article before quoted, tells us of a colored woman in the city of Washington who prepared the deadly Amanita *for the table*, by scraping the plant clean, removing gills and peeling cap, then boiling in salt

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PLATE 8. The Short-stemmed Boletus, *Boletus granulatus*. Slightly reduced. No ring is found on the short stem. The cap is a yellowish mud color. Equally good with the last.

and water, and, after steeping in vinegar, she washed them again, cooked them in gravy, and served with beefsteak! Though it is by no means certain that these poisons could be got rid of by salt and vinegar, if they have already been introduced into the alimentary canal, still it would be well worth remembering and giving them a trial, if one should have eaten of poisonous kinds, and should have found it out before the poisons had been absorbed into the blood, and were nevertheless so far removed from medical aid as to render summoning it impossible or unavailing.

### The Growth of a Mushroom, With Names of Parts.

Very briefly now will be given the development of a mushroom, while at the same time the parts necessary to an understanding of what has gone before or what may follow will be explained.

Mushrooms, like many other plants, produce *spores*, not *seeds*. These spores sooner or later germinate, and give rise to a fine, generally white, stringy, underground portion called the *mycelium*. This mycelium has been observed by probably every one at some period of their lives, if they have ever pulled the bark from a rotten log, stirred up the deep humus in a forest, or opened up a pile of manure or an old straw-stack. The mycelium of the different mushrooms or toadstools is very generally dispersed, and though it may remain more or less dormant through the cold of winter or the dry, hot period of summer, especially if the soil has been deprived of its moisture naturally or artificially, yet as soon as the sun of spring shall have warmed the soil or the rains of fall shall have moistened it sufficiently, little enlargements are formed on the mycelium, which, sooner or later, and ordinarily with extreme rapidity, develop into the "buttons," or young mushrooms, and these proceed to force themselves through the soil and grow upward into the air. This aerial portion is merely a device for carrying the spore-bearing part of the fungus above the surface of the soil, and aiding in the dissemination of the spores by the winds. In many cases the spore-bearing body, called *sporophore*, whatever its form, is pushed up only to the surface of the earth, as in the Puff-balls; at others it is entirely subterranean, when the sporophore must decay before the spores can be liberated, as in the Truffle.

At times the young sporophore is completely covered by a soft covering, which ruptures as the plant pushes upwards, sometimes to leave a cup at the base of the stem and fragments upon the cap, as in the Amanitas; at others to leave a mere remnant in the shape of hairs on cap and stem, as in Cotinarius. In most of the mushrooms this outer covering is completely lacking. As the sporophore grows, it commonly becomes differentiated into a *stem*, and a *cap* surmounting the stem. Under this cap (see chart), in the Agaricaceæ, the Polyporaceæ, and in most of the Hydnaceæ, peculiar organs are developed to support the spore-bearing surface or *hymenium*. In the Agaricaceæ the hymenium is spread over flat plates, which radiate from the center, and are called *gills*. In the Polyporacæ, *tubes*, cylindrical or quite angled, take the place of *gills*. In the Hydnaceæ the spore-bearing surfaces are extended into long or short *spines*. For the characters of those other families of the Hymenomycetes, see the chart. The remainder of the cap, supporting the *hymenium*, is known as the *hymenophore*, a name signifying "hymenium supporter." Projecting from the gills, or other kinds of spore-bearing surfaces, are found, under the microscope, peculiar bodies like Indian clubs, called *basidia*. These basidia bear on their extremities *spores*, varying in number in the different families, but ordinarily four, and raised above the *basidia* on little sharp points, known as the *sterigmata* (singular "sterigma"). In many of the Agaricaceæ and Polyporaceæ the hymenial surface is protected in its early growth through the earth, and in some cases to near full maturity, by a kind of curtain, which joins the edge of the cap to the stem, and is known as the *veil*. As the plant reaches maturity, this veil is ruptured by the lateral growth of the cap, and a part of it may hang from the edge of the cap, or, as is most usually the case, the greater part of it may be left adhering to the stem as a *ring*. The Common Field Agaric, on Plate II, shows the formation and rupturing of this veil to perfection.

In all of the families of the Hymenomycetes (see chart), the *hymenium* or spore surface is *exposed*, and the spores when mature are borne away by the wind. In the Gasteromycetes, another family or division of the Basidiomycetes, the spore-bearing surface is *enclosed* within a covering, called the *peridium*. If we translate the word Gasteromycetes literally, it means "*Belly-fungi*"—an appropriate name, as the spores are all hidden within the belly-like pouch. This *peridium* sometimes opens regularly at top, sometimes very irregularly, and sometimes not at all, unless the irregular scaling-off of the hard covering could be called opening. The Puff-ball is a good example of this family. As this plant comes to maturity it opens on top, the contents are divided up into a loose mass of spores and filaments, and the slightest pressure from the outside will cause to be ejected a yellow or purple cloud of the contents.

In the great class of *Ascomycetes*, a division of the Sporidifera, the spores are not free and placed upon the tips of *sterigmata*, but they are produced in little cases, called *asci* (singular "ascus"), and these asci, together with sterile accompanying bodies called *paraphyses* make up the *hymenium*. In both of these great classes of fungi, the spores are produced *asexually*—that is, without distinctly male and female organs.

## Chart Illustrative of Different Families of Mushrooms.

- 1. **SPORIFERA**—Spores free and naked or soon becoming exposed.
  - 1. **BASIDOMYCETES**—Spores borne on basidia, bodies shaped like Indian clubs, and accomdanied by sterile cells, cystidia and paraphyses, all forming the *hymenium*.
    - 1. **HYMENOMYCETES**—Hymenium free and naked or soon exposed.
      - 1. **AGARICACEÆ**—Hymenium in plates on under side of cap.
        - 1. White spored. Ex. *Hygrophorus.*
        - 2. Yellow spored. Ex. *Cortinarius.*
        - 3. Rosy spored. Ex. *Pluteus.*
        - 4. Purple-brown spored. Ex. *Agaricus.*
        - 5. Black spored. Ex. *Coprinus.*
      - 2. **POLYPORACEÆ**—Hymenium below, tubular or porous. Ex. *Boletus.*
      - 3. **HYDNACEÆ**—Hymenium below, warted or with spinose processes. Ex. *Hedge-hog* or *Bear's Head Fungus.*
      - 4. **THELEPHORACEÆ**—Hymenium on under or outer surfaces, but nearly plane. Ex. *Goblet Mushroom* or *Craterellus.*
      - 5. **CLAVARIACEÆ**—Hymenium covering all sides of upright stems. Ex. *Coral Mushroom* or *Clavaria.*
      - 6. **TREMELLINEÆ**—Hymenium covering free surface, or only one side. Whole fungus more or less gelatinous. Ex. *Tremella, Hirneola.*
    - 2. **GASTEROMYCETES**—Hymenium enclosed in an outer case, called the peridium, through which the spores escape by either regular or irregular rupture. Examples. *Puff balls, Stink horns.*
  - 2. **NON-BASIDIA BEARING.**
    - *3. Coniomycetes.*
    - *4. Hyphomycetes.*
    - None mushrooms.
- 2. **SPORIDIFERA**—Spores enclosed in minute, nearly transparent sacs, called "asci."
  - 1. **PHYCOMYCETES**—Microscopic fungi, none mushrooms.
  - 2. **ASCOMYCETES**—Proper ascus bearers.
    - 1. **DISCOMYCETES.** DISC fungi; spores from 2-8. produced in sacks which are immersed in the flesh of the outer and upper surface of the cap. Ex. *Morel, Helvella.*
    - 2. **TUBERACEÆ.** Subterranean, large, globose, not rupturing. Ex. *Truffle.*

Having thus far discussed mushrooms or toadstools generally, I shall now describe a few of our most common and edible species, illustrated by cuts, shall tell where to find them, and how to prepare them for the table, and shall leave to later bulletins the discussion and discription of many other edible or injurious species. The species described in this paper are the most easily found, the most abundant, and the kinds most commonly collected for the table in America as well as in parts of Europe. It is not the intention to make these descriptions long or scientific, but merely to supplement the plates by a few sentences, telling how these several kinds may be known and where they may be found.

## The Common Field Agaric or Pink Gills.

(*Agaricus campester*). Plates I and II.

This is the plant to which the name "Mushroom" is commonly applied in its most limited application. It is common under many forms both in Europe and America and is the one almost invariably bought in stores under this name. In the first stage at which it is gathered for food, the "button" stage, it is a little, white object closely resembling a puff-ball, about one inch or less high and nearly as wide. If we dig it up, we shall find it differs from the puff-ball in having a distinct stem. Split one of these buttons down, and then we clearly make out, (1) a *stem or stipe*, (2) a *cap* or *pileus*, (3) the *gills* or *lamellae*, and (4) the *veil* or *velum*, a white soft membrane extending from the edge of the cap to the stem. (See Plate II). As the "button" grows into the mature mushroom, the veil is ruptured, and we see fragments of it adhering to the edge of the pileus, while the greater part, becoming entirely separated from the cap, remains somewhat down the stem as a ring or *annulus*, though the ring may occasionally be

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PLATE 9. The Bear's Head or Hedge-Hog Mushroom, *Hydnum Caput-Ursi*. One-third natural size. Grows on old logs in woods, yellowish white to pure white in color. Delicious stewed.

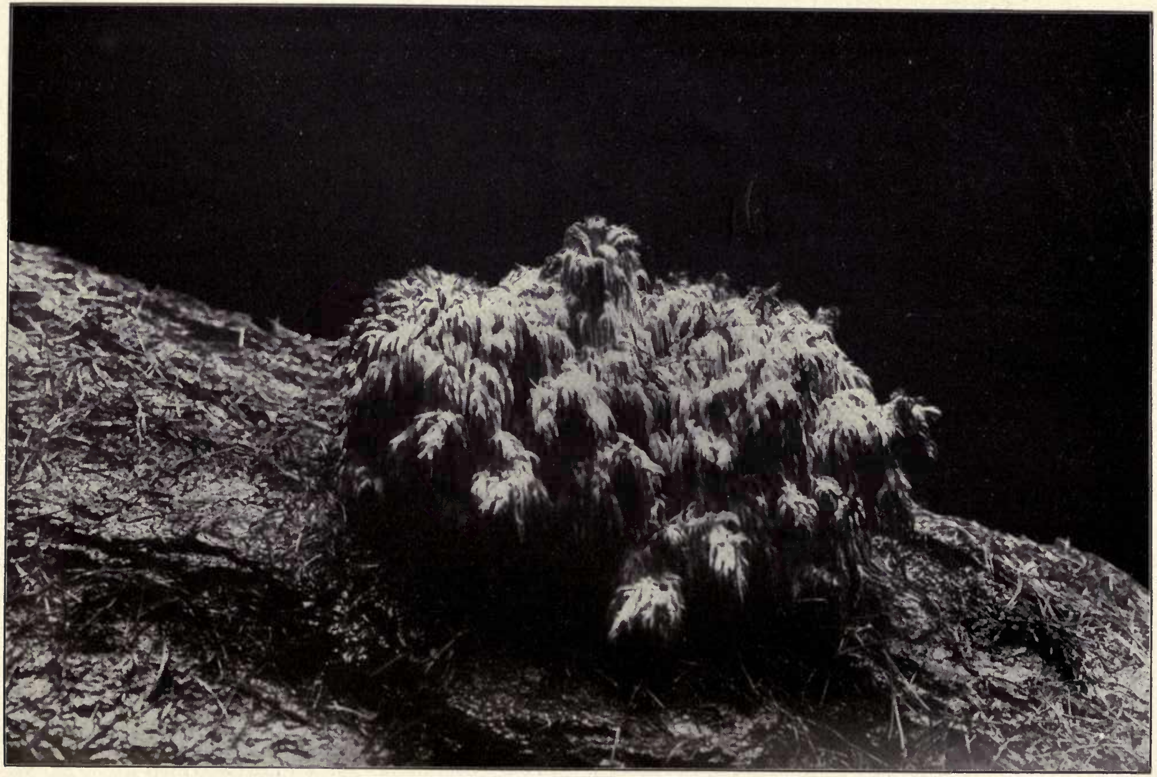

Fig. 9

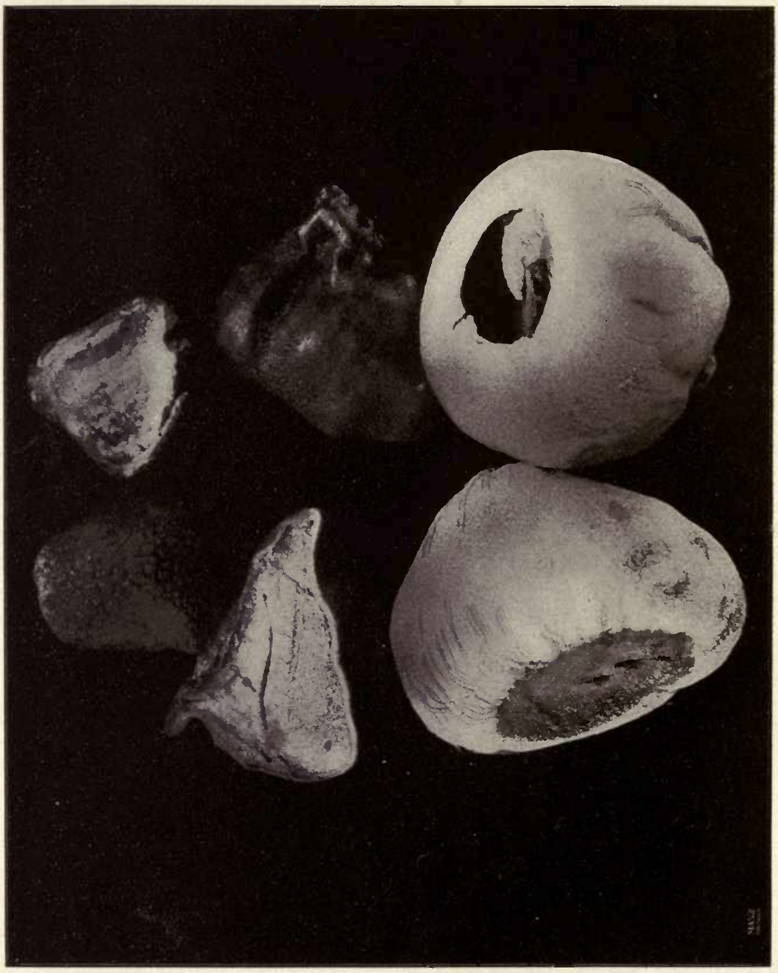

Fig. 10

almost entirely lacking. The cap is from 2 to 5 inches wide, and white, though it varies from smoky-gray to gray-brown, especially as it grows old. The gills when young are *pink* or *flesh-color*, and this has proved one of the best marks by which to separate this species from some of the deadly Amanitas, which have *white* gills. Our plant, moreover, has no *volva* or *cup*, the most common badge of the Amanitas. As the plant matures the spores are formed in great abundance on the gills, and as these spores vary in color from brown to brownish-purple, they soon give the gills a dark color, approaching black. The gills are also *free* from the stem,—that is they are not joined onto the stem, but merely onto the cap, and are of various lengths, some short, some intermediate, some long. The stem is white, generally solid, brittle, and of about the same consistency as the cap, and therefore good as food. It varies in height from 1 to 3 inches and in diameter from ⅓ to ¾ of an inch. It is found growing spontaneously in our moist pastures, especially when enriched by the droppings of cattle. The "buttons", as previously remarked, are produced upon the white, stringy, underground *mycelium*, and gradually enlarging push their way into the air to scatter their *spores*. The vitality of this mycelium or "spawn" is remarkable. It withstands the hottest, driest soils to come out with the first rains of fall as strong and productive as ever. Relying upon this capacity in the mycelium to withstand drought, mushroom growers prepare this spawn for the market, and it is then capable of being sent round the world in its dried condition without injury. What follows is taken mainly from Farmers' Bulletin No. 53, United States Department of Agriculture, entitled "How to Grow Mushrooms", by William Falconer. Two kinds of spawn are in general use amongst our mushroom grow-

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PLATE 10. Puff balls. The two largest have matured and one shows the mode of opening to disgorge the spores. The next one, split in two, is somewhat too old for food, the spore mass turning yellow. The smallest one, but a different species, is just in the state for food, being white and solid within. Somewhat reduced.

ers, one prepared by the English in shapes like "bricks", the other by the French in loose pieces called "flakes". The English "brick" is put up with the mycelium in dry dust manure and compressed, and the more spawn to the brick the better it is. These bricks are then broken up into about a dozen pieces, and these pieces planted. The French "flake" consists of dry mycelium mixed in with dry unrotted horse manure, generally in 3 pound boxes. The flakes are broken up and planted like the pieces of brick. This is generally in cellars, barns, sheds, greenhouses or other buildings where moisture and temperature can be maintained equable. In these places beds can be made, about 14 inches deep, out of common lumber, and filled with the "host" or material upon which the mycelium is to feed. The best material for this purpose is horse manure, or ⅓ cow manure and ⅔ horse, mixed wtth from ¼ to ½ rotted sod loam, and allowed to get through heating by wetting and turning. First fill in the beds with a 6-inch layer of well-moistened, even hot manure, and tramp it down firm. When this has cooled somewhat, put on layer after layer of the prepared manure, raising the under manure with the fork. When the bed is made, throw over it some loose hay or straw to arrest the steam, leaving it on till you wish to plant. Spawn the bed when the heat has fallen below 100° F., about 90° being considered best. Plant in rows, 1 foot apart and 9 inches between pieces. Raise the manure with the hand, insert the piece 2 or 3 inches below the surface, and then press down manure. When the entire bed is spawned, pack the whole tightly, and recover the surface with hay, straw, or mats to keep the surface moist. At the end of 8 or 9 days remove the mulching and cover the beds with good loam 2 inches thick, leaving the surface fine and mellow. The temperature should be about 55° F.,—not lower than 50° nor higher than 65°. Water the beds from time to time, keeping them covered with a mulching till the "buttons" begin to rise. Mr. Falconer says, "Mushrooms are easy to grow and beginners are often as successful with them as are those having an extensive experience. Success depends upon general conditions, good materials, interest in the business, intelligent management, and persistent application."

## The Shaggy-Mane Mushroom.

(*Coprinus comatus*) Plate III.

This handsome and peculiar mushroom must have fallen under the observation of many persons, growing as it does, in our state, along the railroad tracks, cuts and embankments, wherever there is sufficient moisture supplied, from September to November. In and near the city of Moscow hundreds of pounds of this fine mushroom go to waste with scarcely a person to gather it. As I have never seen this species growing in any other localities save those mentioned, it seems as if the Shaggy-Mane must have been introduced through the rolling stock of rail roads and their contents. This may be found to be an error later, and that the plant is indigenous in many localities. It certainly is a conspicuous object when it reaches full proportions on some moist, soft clay bank, with its long white cap looking like a much torn and closed umbrella. The plant when cooked is somewhat stronger than the Field Agaric, but for this very reason is preferred by some persons. The whole plant is whitish or with a little brown discoloration at the top of the cap. The cap is almost cylindrical, rounded at top, and shaggy with scales which are often, especially in their early condition, brown at tip. The gills are long, light colored, and altogether free from the hollow stem, being attached to the underside of the cap. In the "button" stage the cap is connected to the stem by a "veil", which is later ruptured by the elongation of the cap and stem, but differs from the Field Agaric in this: While in that species the "ring" remains attached either wholly or in fragments to the stem, in the Shaggy-Mane the ring is freed from both the cap and stem, and forms a true ring, dropping to the ground as the smooth white stem lengthens. Very soon a change or disintegration begins to show itself in the cap. The gills change to a bluish color, then to a blackish, and then begin to melt or "deliquesce", changing into a fluid black as ink, composed of water and the now ripe and black spores. While this change is going on in the gills, the edge of the thin cap becomes lacerated, bends up and out, and when the deliquescence is completed is found on the top of the as yet smooth and unimpaired stem,--a flattened mass with backward rolled edge, and dripping with the black fluid. As soon as the gills commence to discolor, the plant is unfit for food, while it is at its best before the ring has become separated from cap and stem, or while it is still in the button stage. Wash the caps before cooking to get off any dirt, but especially to remove the fluffy scales.

### The Ink-Cap.

(*Coprinus atramentarius*) Plate IV.

This plant somewhat resembles the Shaggy-Mane, but in our State it is nearly always devoid of scales. It is always egg-shaped or oval, not cylindric like the last, and of a darker color, varying from ashen gray to smoky brown, almost always "striate" or furrowed, with a shorter stem and no separating ring, but in its place an irregular and prominent line surrounding the stem near its base. It is not nearly so common as is the Shaggy-Mane. It is sometimes found growing singly, but more commonly in clusters from 3 to 12. The stem is smooth above the ring, and somewhat scaly below it. In the specimens shown in the plate, the ring has been entirely washed off in freeing the plants from the heavy clay in which they grew. The plant melts away to scatter its spores just as does the Shaggy-Mane, and receives its name of "Ink Cap" from the striking resemblance the cap bears at this period to an open ink-well. Mr. McIlvaine tells us that he has used the fluid as an ink with which to draw a picture of the fungus.

PLATE 11. The Morel *Morchella bispora.* Slightly reduced in size.

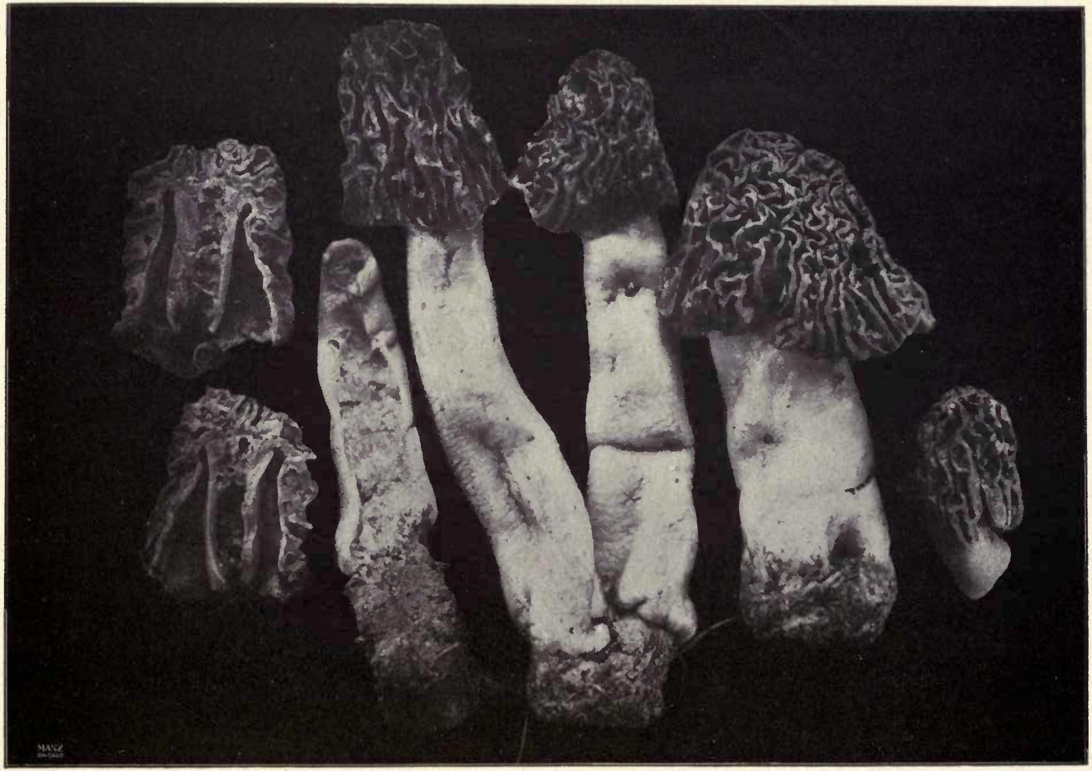

Fig. 11

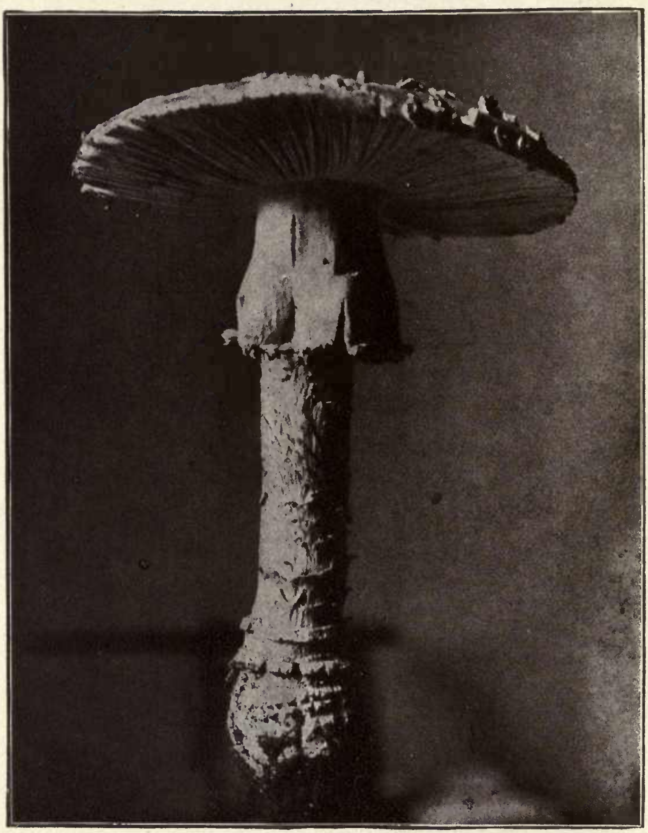

Fig. 12

## The Ivory Hygrophorus.

(*Hygrophorus eburneus*) Plate V.

This very pretty mushroom is found in immense quantities in our moist pine woods on north slopes. Owing to the very slimy coat of gluten which covers cap and stem, causing it often to slip from your hands like an eel, it is not an agreeable plant to handle; but when cleaned nicely and cooked into a stew, we lose all thought of its disagreeable exterior in admiration of its delicate oyster flavor To the writer this flavor excels that of any of the former mushrooms, and makes it one of the most savory ever tasted. It has a decidedly vegetable rather than meat flavor, with a delicate reminder of oyster or clam. Its ivory-like color and lustre, together with its slimy coat, well serve to distinguish it from any of the other white mushrooms, many of which are found in our forests and at a distance can hardly be distinguished from the Ivory Hygrophorus. It is widely distributed in Europe and America, and tons upon tons could be collected on any of our wooded hills from September to far into December, if the temperature will allow, as it did this year. The plants vary much in size, from 1 to 4 inches wide, and from 2½ to 6 inches high. The gills are white like the rest of the plant, and are conspicuously "decurrent", that is they run down the stem from the cap for quite a distance. The stem is generally bent over to one side, and oftenest tapers downwards. The pileus or cap is moderately thick, generally flat or convex, though at times as the plant grows older it becomes tilted upwards, and is always incurved along the edge when young. The spores are white. Many other species of this interesting genus are to be found abundantly in our fir woods, or in forests of mingled pine and fir, but the discus-

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PLATE 12. Fly Amanita, *Amanita muscaria*. Poisonous One-half natural size. F. V. Coville, Circular No. 13, Department of Agriculture, Division of Botany, "Observations on Recent Cases of Mushroom Poisoning in the District of Columbia".

sion of these will be reserved for future bulletins. As far as the writer has observed they are all edible, and though of various shades from white, yellowish-white, yellow, yellowish-red, to dull brownish or dirty olive, they all agree in these important generic characters: the gills are rather distant, of a waxy consistency broadening towards their attachment to the cap, and the central portion of the gill, called the *trama*, is but a continuation of the material of the pileus, so that when they are pulled off from the cap, they each leave a projecting line of the trama behind them on the cap.

## The Gray-Gilled Hypholoma.

(*Hypholoma capnoides*). Plate VI.

This toadstool is one of the most choice we have, and is agreeable either raw or cooked. It is commonly found about old stumps, though it is by no means uncommon where dead wood has decayed, or where rotten roots come near the surface of the ground. It so closely resembles another Hypholoma of this section, that the taste is the best means of distinguishing them. Chew a little piece. If the plant selected is of our species, it has a sweet nutty taste; if it belongs to the closely related *H. fasciculare*, growing in just such spots, it is as bitter as gall. To the observant eye there are other differences which distinguish these two species. The Bitter Hypholoma has a yellowish cap and a yellowish-green cast to the gills; the gray-gilled Hypholoma has a cap of yellowish-red to dark red at the center, and the gills are of a decided *purplish slate* color.

This genus of plants furnishes many edible species all over the world, and many are to be found in our own country. The main marks of distinction by which this toadstool may be known are these. The plants generally grow in clusters and often together ("connate") on flexuous stems 3 to 6 inches long and ¼ to ½ inch thick. The caps are yellowish-red, darker in the center and from ½ inch to 2 inches wide, fleshy, convex to flat, smooth. Flesh white or with a slight shade of lemon. The gills are attached to stem (*adnate*), but separate easily, are broad and close together, and of a purplish-slate color when mature and covered by the spores, though light colored before the spores darken them.

## The Chestnut-Colored Boletus.

(*Boletus Clintonianus*). Plate VII.

On referring to the plate, it will be seen that this plant is radically different, when viewed from below, from any of the mushrooms so far described. While all of the previous kinds had gills radiating from the center to the circumference, these have *pores* scattered irregularly over the lower surface of the cap, or in one genus radially arranged though definite pores. Still this distinction is more apparent than real, for some of the Agaricaceæ have gills approaching pores, while some of the Polyporaceæ, to which belongs the Boletus, have the pores radially arranged and longer than wide, thus approaching the first family. Both have "basidia", with the "spores" placed on "sterigmata", and accompanied by sterile bodies called "cistidia".

The Boleti give us probably more edible and at the same time larger mushrooms than any other genus. Prof. Peck, who has made an exhaustive study of this genus, enumerates about 120 species in America, the greater part of which are edible, though some are intensely bitter, and a few are poisonous. Though the poisonous species are mainly limited to species *possessing red mouths to the tubes*, there are some intensely bitter and even suspicious kinds outside of this section of *Luridi*, as it is called; so it best to test each individual carefully by the rules laid down previously. This has been my method of procedure with this species and with others, and I have found that when I collected the caps of this Boletus, cleaned them carefully and removed the tubes (which cook slimy), it is very fine fried or broiled. This is a very common and conspicuous toadstool in our pine woods, and a basket-full can be collected in a short time throughout September and October, while it is not a rare plant in other months.

The plants vary from 2 to 3 inches in height, the caps from 1.5 to 3 inches broad, and the stem from ¼ to ½ inch thick. The cap is generally a fine red-brown though it may be yellowish, and when fresh is very slimy. The flesh is yellowish and thick. The stem has a more or less noticeable *ring*, which at first covers the tubes as a glutinous *veil*. The spores are oblong-spindle shaped, and of a yellowish ironrust cast.

## The Short-Stemmed Boletus.

(*Boletus granulatus*). Plate VIII.

This plant is much like the last in size, but it can easily be told from it. The cap varies in color from a light dirty yellow to gray-mud; the stem is short and without ring or veil. More exactly the plant may be thus described: The pileus is convex to nearly plane, ordinarily somewhat undulate or irregular, very viscid when moist, varying from yellowish to grayish-brown; flesh pale yellow; tubes short, growing close up about the stem, yellowish, the mouths *granulated*; stem dotted with glandules above.

This mushroom is in excellence equal to the former and is found growing with it, though it seems to prefer the deeper woods. I have found it, however, growing on bare spots on hill-tops, unprotected by but not far from trees.

Other Boleti are found in our woods, but as they have not been tested by the writer, they will be left for future bulletins.

## The Hedge-Hog or Bear's-Head Mushroom.

(*Hydnum Caput-Ursi*). Plate IX.

This very conspicuous mushroom is found quite commonly in fir forests, growing up from or hanging down from some old log.

Its whiteness and beauty (see plate) make it a very conspicuous object, and one who has once seen a large specimen of this plant is not likely to forget it or to mistake it, except for closely related species. It belongs to another family of the Hymenomycetes or Free-spored Mushrooms, viz. the *Hydnaceae*. These fungi are noted for having the hymenium arranged on *spines* or *tubercles*, which are ordinarily situated on the under side of the cap, but when they grow, as does this plant, either on the upper or under side of a log, the spines may be considered as growing either on the upper or under side of the cap. There are several closely relately species of Hydnum belonging to this section of the plants, but as they are all edible, and as this is the only one found in our neighborhood, one will answer for all. The plants vary from 6 to 8 inches high, and as much or more across. The tufts are pendulous or upright, compact, white or with a yellowish tinge when old or dry. The spines are from ¼ to ¾ of an inch long, round, and pointed. The branches come off in every direction and are short.

This plant when washed and minced, and then cooked like oyster-stew, makes an excellent dish.

## Puff Balls.

*Lycoperdon*, of different species. Plate X.

Very few would suspect that these common plants, filled when ripe with a powdery dust consisting of mingled spores and tissue, and looking at this time any thing but appetizing, are *when young* solid, white within, nearly all edible, and some delicious. In the plate are shown four plants of two different species. Two are mature, have opened by an irregular chink at the top, and are ready to eject the spores. Two are cut open and are exposed each with one cut side down, the other up. In the larger, the spores have begun to form though it is still of solid consistency, and the spore-bearing portion is taking on a yellow color. The plant is too old to be at its best, though it is not hurtful even at this stage. The other is solid all through, white, and is just at its prime for eating. It has been found by many who have eaten puff-balls, that the *larger* species are much better than the smaller ones. One, known as The Giant Puff-ball, *Lycoperdon giganteum*, or *Calvatia gigantea* according to some, is so rare in Idaho that it has not been represented by chart, though there is a specimen in the University Herbarium, and found near Moscow, which is 14 inches long, 11 inches wide, and 5 inches thick. The "Country Gentleman" some years ago mentioned a giant puff-ball which weighed 47 pounds and measured a little over 8 feet in circumference. Vittadini says of them "when the giant puff-ball is conveniently situated, you should only take one slice at a time" (more if you need it) "cutting it horizontally and using great care not to disturb its growth, to prevent decay, and thus one may have a fritter every day in the week." They are certainly delicious when sliced and fried in butter like egg plant.

The two species represented in the Plate are our most common ones, *Lycoperdon caelatum* (Calvatia caelata of some), and *Lycoperdon gemmatum*. I have only tried these raw, and find them both good; but those who have cooked them both say that the first, the larger, is much the better. The small species are said to be rather strong. However, no puff-ball is poisonous, or even injurious, so one can hardly make a mistake if several species are gathered, save that some are better than others. *L. caelatum* is known by its top-shaped *peridium* or coat, white to light cream in color, 3-5 inches in diameter, granulate rough or almost smooth, and flat above or somewhat depressed, and breaking away by a large irregular hole at top. The spores and fibres are yellowish green or olivaceous. *L. gemmatum* is smaller, generally more tapering at base, and the top and sides of the peridium are rougher with conical, white projections.

## The Morells.

*Morchella bispora*, and others

These peculiar plants differ from any of those described in having the spores enclosed in *sacs*, and these immersed in the substance of the cap so that their upper ends are about even with the upper surface. They do not therefore belong to the *Sporifera*, with spores, free or inclosed, on the ends of basidia; but to the *Sporidifera*, with spores in sacs, and to the family Discomycetes, or Disc Fungi. There are many species belonging to the genus Morchella, this one being a rare species, with but two spores to the ascus or sac, and hence it is called *Morchella bispora*. All that have been tried have been found to be esculent, but on account of the rarity of this species, I doubt whether it has often been tested. Dr. Taylor in his "Mushrooms of America", says it is edible. Care should be exercised that these fungi, if to be eaten, are always in their prime; not infested with larvæ, nor too old, since from a closely related genus *Gyromitra esculenta*, the deadly "helvellic acid" has been separated. As before stated even this species, when at its prime, has been eaten by many parties without experiencing the slightest inconvenience. Even should this acid be found in species of this genus, it would probably only be found in specimens in too advanced a condition. The species quite common in the west as in the east, *Morchella conica* and *M. esculenta*, are equally celebrated in the "cuisines" of Europe and America as "*the* morells".

The genus Morchella is easily known (See Plate XI.) by the dark corrugated cap and the light stem. These corrugations run up and down the cap like the convolutions of the brain, and do not consist of rounded knobs, like a thick cluster of grapes, as in Gyromitra. In this species, M. bispora, the cap is rather wide, and free from the stem up to the top; the stem is white and rather long; the asci or sacs contain but two large spores.

It is the intention of the writer to continue these bulletins on edible and poisonous mushrooms until most of our largest and best-defined species have been described. This cannot be done until more careful trials have been given them to find out whether they are edible or not. Sufficient species have, however, been described in this number to allow a selection to every one for many months of the year.

# RECIPES.

The following recipes I have taken wholesale from the books of McIlvaine, Atkinson, and others, thinking that I do violence to no one's prerogatives in letting people know the best recipes of some of the best cooks in America.

### To Prepare and Cook Agaricus.

They can be collected up to the time the gills begin to soften. Cut off the extreme butt of the stem. Rub off the cap and stem with a towel or flannel. Do not peal. Wash in cold water. Drain well, gills downward.

#### *BROIL.*

Use well spread caps only. Use double iron broiler. Place the caps on it, gills down, and broil two minutes, turn and broil two minutes more. While hot, season with salt and pepper, and butter well, especially upon the gill side. Serve upon toast.

#### *FRY.*

Lay them in a frying pan in which butter has been heated boiling hot. After frying five minutes, serve on a hot dish,—pouring over them the sauce made by thickening the butter with a little flour. This is as delicious as more elaborate ways of cooking and retains the mushroom's distinctive flavor in full perfection.

#### *STEWED ON TOAST.*

Cut the mushrooms,—caps and stems—into pieces of equal size. Place in a covered saucepan. To each pint add one ounce (two level tablespoonfuls) of butter. Enough water will have been retained by gills after washing to make sufficient liquor. Stew slowly twenty minutes; season to taste with pepper and salt. place upon toast.

## *STEWED.*

To each ponnd allow two ounces of butter. Put the butter into a saucepan, and when melted, not brown, throw in the mushrooms either whole or cut into slices; sprinkle over a teaspoonful of salt; cover the saucepan closely to keep in the flavor, and cook very slowly for twenty minutes or until they are tender. Moisten a rounding tablespoonful of flour in a little cold milk; when perfectly smooth, add sufficient milk to make one gill; stir this into the mushroom, add a salt-spoon of white pepper, stir carefully until boiling, and serve at once. This makes a fairly thick sauce. Less flour is required when they are to be served as a sauce over chicken, steak or made dishes.

## *PURÉE.*

Wash carefully a half pound of mushrooms; chop them fine, put them into a sauce pan with a taplespoonful of butter, and if you have it, a cup of chicken stock; if not, a cup of water. Cover the vessel and cook slowly for thirty minutes. In a double boiler put one pint of milk. Rub together one tablespoonful of butter and two tablespoonfuls of flour; add to it the milk; stir and cook until thick; add the mushrooms, and press the whole through a sieve; season to taste with salt and pepper only.

## *CREAM OF MUSHROOM SOUP.*

This will be precisely the same as the preceeding recipe, save that one quart of milk will be used instead of a pint with the same amount of thickening, and the mushrooms will not be pressed through a sieve.

## To Prepare and Cook Croprinus.

## *BAKE.*

Being soft and juicy, they must be handled with care, and are much better cooked with dry heat. Remove the stems and wash them carefully; throw them into a colander until dry; arrange them in a baking pan; dot here and there with bits of butter, allowing a tablespoonful for each half pound of mushrooms; dust with salt and pepper, run them into a very hot oven, and bake for thirty minutes; dish in a heated vegetable dish, pouring over them the sauce from the pan.

### *STEWED.*

Wash and dry them; put them into a large, flat pan, allowing a tablespoonful of butter to each half pound of mushrooms; sprinkle at once with salt and pepper; cover the pan and stew for fifteen minutes. Moisten a tablespoonful of flour in a little cold milk; when smooth add a half cup of cream, if you have it; if not a half cup of milk. Push the mushrooms to one side, turn in the mixture and stir until boiling. Do not stir the mushrooms, or they will fall apart and become unsightly. Dish them; pour over the sauce and serve them at once. Or they may be served on toast, the dish garnished with triangular pieces of toast.

## **How to Prepare and Cook Boleti.**

### *BAKED.*

Wash the caps and remove the pores; put the mushrooms into a baking pan; baste them with melted butter, dust with salt and pepper, and bake in a moderately quick oven three quarters of an hour; dish in a vegetable dish. Put into the pan in which they were baked a tablespoonful of butter. Mix carefully with a tablespoonful of flour and add a half pint of stock, a half teaspoonful of kitchen bouquet or browning, the same of salt, and a dash of pepper; pour this over the mushrooms, and serve.

### *FRIED.*

Wash the caps and remove the pores. Dip the caps in beaten egg, then in bread crumbs, and fry them in smoking hot fat; oil is preferable to butter, even suet would make a drier fry than butter or lard. Serve at once as you would egg plant.

### *BROIL.*

Remove stems and cap, unless young, or the dish will be slimy.

Wipe the caps clean. Put on a wire broiler or in a hot buttered pan. Cook well. Add butter, pepper and salt.

### To Prepare and Cook Hydnums.

Use the tender parts only of stems and caps of the capped species, and soft, fresh parts of the maned species; cut into small pieces of similar size, stew slowly in covered sauce pan for from thirty to forty minutes, season with butter, pepper and salt. Serve.

### To Prepare and Cook Puff-Balls.

#### *FRY.*

Remove the outer rind, slice, dip in egg and bread crumbs, and fry as egg-plant; serve.

#### *STEW.*

Cut in dice-shaped pieces, stew for 15 minutes in a little water, pour off the water, dust with a little flour, add a small quantity of cream or milk, butter, pepper and salt, and a little parsley. Stew slowly for five minutes. Serve. The puff balls should be perfectly white inside; any stains or yellow part should be removed, otherwise they will be bitter.

### To Prepare and Cook Hypholomas.

#### *STEW.*

Wash the caps, stew slowly in the water which the gills retain for half an hour, keeping dish covered. Add plenty of butter, pepper and salt to taste, add cream or milk with a little thickening.

Most of the Hypholomas have a slightly bitter taste, of which most persons become very fond; if it is objectionable, add a small amount of lemon juice or sherry.

### A Hunter's Toast.

Carry a vial of olive oil or a small can of butter, some pepper and salt mixed. An edible toadstool found, collect a few dry twigs, fire them. Split a green stick at one end; put the toadstool in the cleft, hold it over the fire; oil or butter, season. Eat from the stick.

Dozens of more intricate ways of cooking mushrooms can be found in McIlvaine's "One Thousand American Fungi" and in Atkinson's "Mushrooms Edible, Poisonous etc.", but we have endeavored to select the shortest and simplest recipes from both works.

6 Feb,

Walter Mulford

UNIVERSITY OF WYOMING.

Agricultural College Department.

# WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

## BULLETIN NO. 40.

JANUARY, 1899.

# The Trees of Wyoming and How to Know Them.

BY AVEN NELSON.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.

—(11)

# Wyoming Agricultural Experiment Station.

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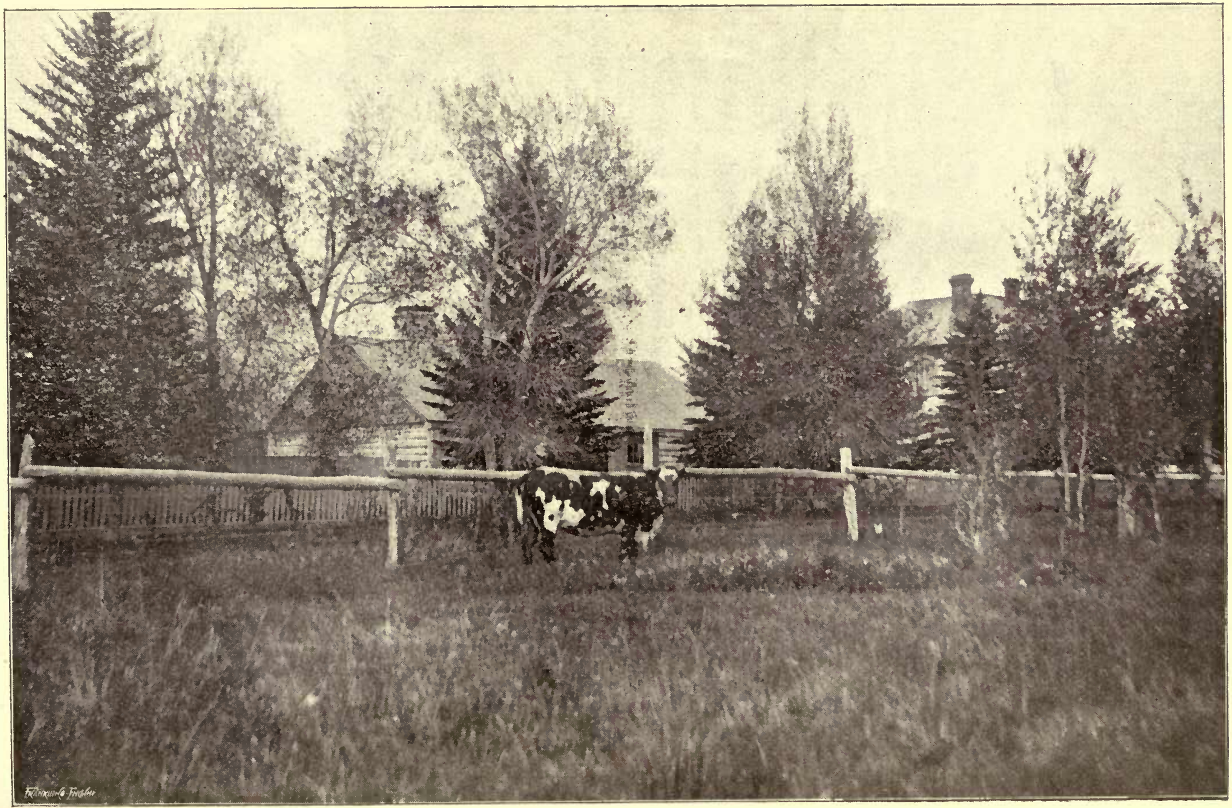


I. **AMONG THE TREES.** *A Wyoming Home, Ft. Bridger.*

# THE TREES OF WYOMING

. . . AND . . .

# HOW TO KNOW THEM.

AVEN NELSON.

## INTEREST IN NATURE.

> "In Nature's infinite book of secrecy,
> A little I can read."—*Shakespeare.*

How Developed.—We are, as a matter of course, indifferent to individuals and subjects to which we are strangers. Personal interest *in* and love *for* a thing are the result of intimate acquaintance with the worthy object. We *read* of love at first sight, but that affection that makes us willing to serve and defend the one or the thing that we cherish is evolved only through continued, helpful association. No subject of human interest has been promoted or defended worthily except by those who were its friends because they had real knowledge of its worth. The beauties of literature are evident to those only who through intimate knowledge of it are prepared to feel its power. Science is advanced by those who have comprehended its aims and are thereby made its devotees. Nature appeals with feeble voice to him who is a stranger to her. A Thoreau, a Burroughs and a Lubbock were cradled in her opulent lap and there learned the secrets that they so lovingly express.

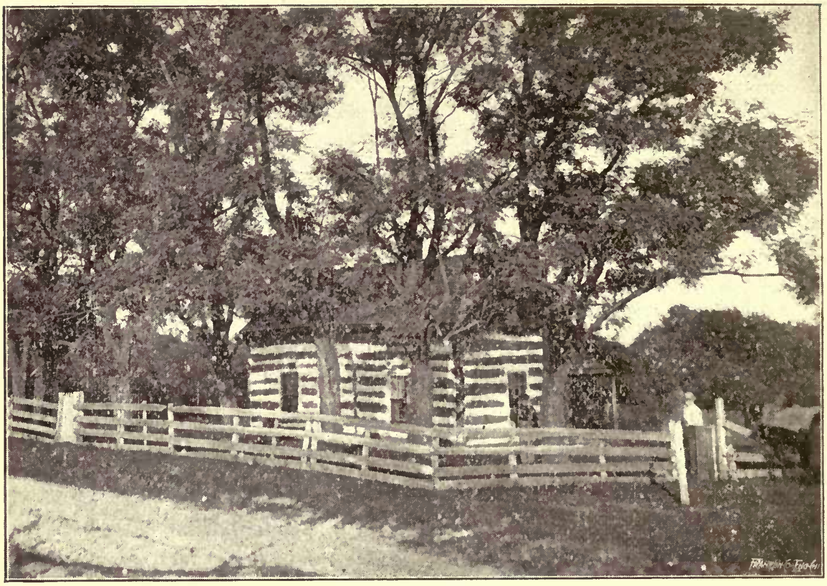
The Condition in Wyoming.—In this fair state many of us seem to have been too busy to hold communion with Nature's visible forms. Because we lack knowledge concerning her we have been indifferent to her language and her inspiring beauty. With the sterner aspects that present themselves in bleak, wind-swept plain, in the roaring blizzard, and in the beetling crag of mighty mountain we are all familiar. We are often nearly strangers to her more lovely traits because these develop outside the beaten paths. Yet some there are who have learned to know, and knowing have learned to love her in her gentler moods:—have learned to know that here beneath the bluest skies, softest breezes play; that fragrant flowers of rare beauty deck every hillside; that sweet streams murmur in every mountain valley; that many a crystal lake mirrors sky and shore; that emerald mosses occur in every shaded nook and lichens cover every rock and crag with gayest yellow and softest gray; that stately trees crown many a hilltop and forests dark and dense clothe in solitude every mountain side.

We are rich in those elements of natural scenery which appeal to the higher sentiments of our nature, but too often we are forced to live so apart from them that we miss much of the good that ought to come to us from that source. Three-fourths of the people of Wyoming live in towns upon the various lines of railroad. Two-thirds of these towns are situated on the open and comparatively barren plains. In some of these many of the first settlers thought of them simply as temporary places of abode. This, added to the natural difficulties encountered in adorning the home and public grounds, left our homes in desert-like places and our lives impoverished from a lack of those things to which our sentiments would cling through all the passing years.

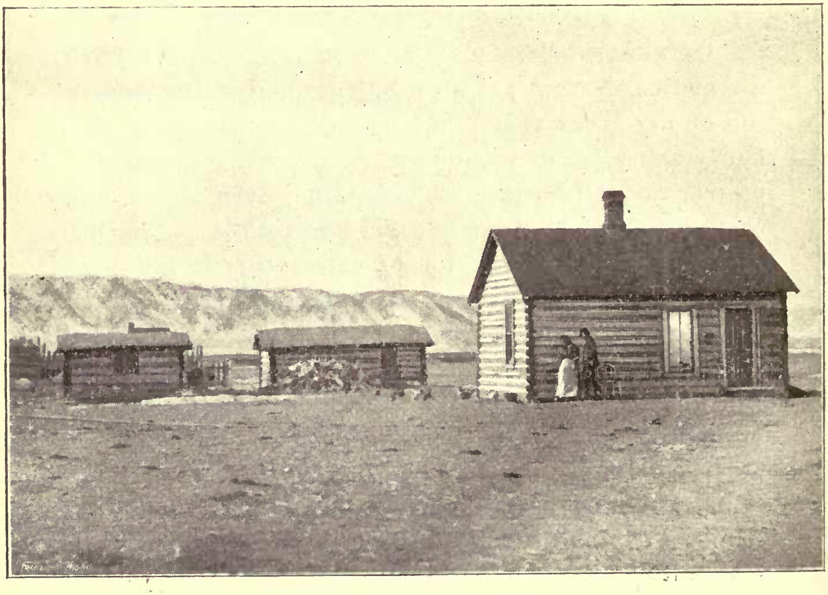
Who among us, of maturer years, does not recall with interest or almost worshipful affection some stately tree, shaded lane or secluded forest nook of our childhood's home? But there are towns in our state *today* without a tree or shrub or even a bit of lawn. Our children are missing that element of refinement which comes from beautiful surroundings outside the home. Girls and boys are nearing maturity in some localities in the state to whom any tree would be of interest and to whom a glimpse of a fruit tree in blossom would be as a glimpse into Paradise. There are homes in abundance where the sentiment expressed in the following lines would find no answering chord:

"Woodman spare that tree,
Touch not a single bow;
In youth it sheltered me
And I'll protect it now."—*Morris.*

INCREASING INTEREST ELSEWHERE.—In many parts of America, Nature has been so prodigal in the distribution of her trees that what we owe to them has been poorly appreciated. Just now, however, a great wave of interest and enthusiasm is sweeping over the country which it is hoped will make trees and forests as cherished here as they have been for centuries in the old world. Shall not Wyoming have a part in this growing interest? Shall we not learn something of the treasures of our hills and mountains? Shall we not bring into our lives and into the lives of our children some part of the enjoyment and help that comes to those who are in touch with Nature? Sir John Lubbock says: "The love of nature is a great gift, and if it is frozen out or crushed out, the character can hardly fail to suffer from the loss." If this be true it would be well for us to remember that this ele-



II. "THE OLD HOME."



III. "THE NEW HOME."

TREES VS. TREELESSNESS.

ment in our character, if it is to grow or even to live, must have something to feed upon. We must surround ourselves with those natural elements of beauty to which our sentiments can go out. These are prodigally abundant in our mountains, but Nature has dealt less kindly with our great plains.

DEVELOPMENT OF INTEREST.—We must look before we can expect to see; we must see before we can know; we must know before our interest will be aroused; our interest must be aroused before we will exert ourselves to bring about the clothing of even our home grounds with those grandest elements of beauty in any lanescape—trees.

"No tree in all the grove but has its charms."—*Cowper.*

Knowledge brings interest, interest brings action. But to whom may we appeal to disseminate this knowledge? Surely to all who have ever loved the trees of the old home; to all whose children are growing to manhood or womanhood in any treeless town; to all whose ranch homes lie upon the wind-swept plains, and especially to those into whose hands we are entrusting the mental training of our children. Yes, we can certainly hope that our teachers will interest themselves in this branch of nature study that promises so much of good to the individual pupils and to the community as a whole.

A CASE IN POINT.—The early explorer who ventured beyond the Missouri and the pioneer settler in what is now Nebraska found the whole trans-Missouri region a treeless, wind-swept plain, the more western part at least being included in the hypothetical "Great American Desert." Little by little the boundaries of this desert are contracting and we may hope for its ultimate extinction.

Nebraska, recently the treeless state of the Great plains, is no longer treeless. Orchards here, shady lanes there, and groves yonder meet the eye of the traveler as he is whirled across its broad acres. No longer can the eye follow the landscape until the gray of the undulating hills blends with the gray of the sky on the distant horizon. Its transformation in one generation from dreary treelessness to restful though animated homelikeness must be considered one of the achievements of the age. This result is certainly one of the factors that have contributed to the greatness of our neighboring commonwealth.

One of the most potent influences in bringing about this desirable result has been the awakening of a public sentiment, in regard to trees, the like of which has nowhere else in the United States been secured—and all this largely through the schools. The school touches every home. Let the light of enthusiasm shine out in the teacher, then soon the whole school is ablaze with eagerness and the reflection extends even beyond the neighborhood bounds.

This sentiment for trees and enthusiasm for tree planting reached its climax in Nebraska in the years immediately following the establishment of Arbor Day, at the suggestion of Hon. J. Sterling Morton. He will be gratefully remembered for that act long after his other public services have been forgotten, not only in Nebraska but in all the states where Arbor Day has become an established institution—an institution the observance of which is now all but universal.

Speed the day when interest in this subject shall sweep over Wyoming, and, to hasten its coming, may we not hope to enlist the co-operation of all the teachers within our borders? Pupils and parents will alike be interested in the trees of the state in their homes and in their relation to ours. In what way can we better begin to develop this interest than by learning to know them? We shall then soon find springing up a desire to enjoy, to own and to protect them.

## FOREST RESERVATIONS.

"I regard the forest as an heritage, given to us by Nature, not for spoil or to devastate, but to be wisely used, reverently honored, and carefully maintained. I regard the forest as a gift entrusted to us only for transient care during a short space of time, to be surrendered to posterity again as unimpaired property, with increased riches and augmented blessings, to pass as a sacred patrimony from generation to generation."—*Baron von Mueller*

The setting aside by the General Government of large tracts of forest lands, in various parts of the United States, to be preserved perpetually as forests, has met with much favor in most parts of the country. Some criticism arose at first from a few who feared that private interests might suffer or that certain industries, such as mining, might be hindered in their development. Now, that fuller information has shown that the purpose of this forest legislation is wholly beneficent and that it is not intended that these laws shall work a hardship on any one, even those who were at first inclined to criticise are now warm advocates of the policy. The early criticism proves to have been a good thing. The attention of the whole country has been called to the great benefits we derive from forest covered lands.

INFLUENCE OF FORESTS.—While this is not the place for a discussion of this question, yet it may be well to mention a few of the points. First, it is well known that large, wooded areas exert a great influence upon the climate of adjacent regions, i. e., temperature, moisture and healthfulness are affected by them. Of greatest importance, however, is their conservation of moisture whether it falls in the form of rain or snow. To the wooded summits and slopes of our mountains we owe the fruitfulness of the valleys and plains below. The rain is taken up by the loose soil and leaves and sinks into the crevices among the rocks. Days and even weeks pass by before it all finds its way into the brooks and streams. When it does reach these it literally filters into them as clear and sparkling as if it had verily been distilled. The snows of winter, protected in the shade of the dense woods and piled in great drifts in the canons, linger even in the lap of summer, feeding slowly but surely the many life giving streams upon which the vegetation in the valley and on the plain depends. It will easily be seen that the forests hold back what would otherwise be flood waters in the streams that drain the region. So it happens that communities hundreds of miles from the great forest reservations are interested in their perpetuation.

Contrast the condition in open country or where the timber has all been removed. Rains that fall upon naked slopes run off with a rush, carrying the soil off with the water and washing out gullies, ravines and even canons. In open regions we have seen the muddy streams overflowing their banks after a shower or following the melting of the spring snows. The soil is all washed away, making worthless many a once valuable acre. The water courses in such regions, during dry periods, instead of being clear, flowing streams are little more than stagnant, muddy pools.

Wyoming is fortunate in the possession of several heavily forested mountain ranges. She is thrice blessed in having within her boundaries three regions deemed worthy of protection and preservation by our Government. Let us hope that these may remain to bless the people, both within and without our boundaries, through all time to come. May national interest demand the preservation of the mighty forests that crown the summits and cover the slopes of the Wind River mountains also.

Nature has further made amends for our wind-swept plains by giving us a fourth Forest Reserve, one in which the whole world has an interest as the great Wonderland. This is the region where are conserved the waters that feed the rivers of a continent. In Yellowstone Park are the headwaters of three great river systems, the Missouri, the Columbia and the Colorado, not to mention many smaller streams that are ultimately tributary to these.

A PLEA FOR A PROTECTIVE POLICY.—Shall not we, as citizens of the state which has most to gain, loyally support a policy that means so much to our arid plains? Under the past reckless management, or rather total want of supervision, enough timber has been destroyed by forest fires (often wantonly kindled) to bountifully supply the entire state for centuries. Under a wise protective policy our forests can be made to yield all the timber that we can possibly use for domestic purposes, without in the least impairing their beauty, extent or productiveness. If we learn to know our forest resources and their value to us, then we shall come to appreciate them so highly that we shall stand as a unit for their protection from those who would destroy them for private gain. We shall also desire to protect them from the consequences of the present reckless indifference that allows the destruction of thousands of acres of valuable timber by fire. Who has not felt the desolateness of what would otherwise be the most charming scenery were it not for the dead and fallen trees that strew the blackened slopes. The writer has in mind two places in the state, making some pretensions as mountain summer resorts, which, with their limpid lakes, would have all the elements of natural beauty were not the whole effect marred by unsightly, blackened stumps and progress impeded on every hand by the tangled, fallen timber.

## NAMES.

COMMON NAMES.—That it would be a most desirable thing to have a good expressive English name, not only for our trees but for all the important plants, is freely admitted by all. In fact it seems so desirable that great effort is being made by those who think and write upon these subjects to hit upon some good "common name" upon which all can unite. The difficulties encountered, however, are great, for not only do most plants have different common names in different localities but, what is worse, very different plants have the same common name. To illustrate: One of our commonest trees, Lodge Pole Pine, is also called in Wyoming, Tamarack and Black Pine; in Utah, Prickly Pine; in Montana, White Pine; in Colorado, Spruce Pine, and, possibly in other places by yet other names. Then these names are also applied to other trees, as, for instance, Tamarack to one other species of Pine and to two different species of Larches and possibly to other trees. How then shall we know what tree is meant when we hear a name? No way suggests itself except that we must, as a people, agree upon the most expressive, available name. Then we must learn to know that tree and must apply no other name to it and that name must be applied to no other tree.

The names suggested in this bulletin are not original with the writer but such are chosen from those in common use as have secured the approval of men who have given much time and thought to this subject.*

LATIN NAMES.—The scientific names have a great advantage in that only one name can properly be applied to the plant in question and that the oldest one. By this name the plant must be known the world over. Such a name consists of two parts, the first or generic name which, in a way, corresponds to a person's family name and the second or specific name which points out a particular kind much as a given name points out a particular person. To illustrate: The Pines belong to the genus *Pinus;* the Cottonwoods are *Populus.* To point out a particular kind (species) another word is added, as *Pinus flexilis* (The Limber Pine) or *Populus balsamifera* (Balm of Gilead). It is customary to add the name (or abbreviation of it) of the person who first describes the species or brings the right generic and specifis name together. Thus the two just given should be written *Pinus flexilis* James, and *Populus balsamifera* Linn.

Now these Latin names are not so difficult to learn or to understand as most people imagine. They are in fact more easily remembered than common names for they are often descriptive of some character of the plant as may be seen in those given above.

---

*Mr. George B. Sudworth in the excellent bulletins of the Division of Forestry, U. S. Dept. of Agriculture is doing much to bring order out of the chaos of common names. I am glad to acknowledge my indebtedness to Bull. No. 17 of that Div.

In the following pages the scientific name is printed in parenthesis, in italics, under the common name. It is hoped that those who really wish to know our trees by the names now accepted for them everywhere will familiarize themselves with these names in particular.

# THE TREES OF THE STATE.*

## TREE DEFINED.

Woody plants which continue to grow for some years are known either as shrubs or trees. Size is usually made the line of separation between the two but the form of growth is quite as characteristic. The following quoted definition seems to express the commonly accepted idea of a tree: "Trees are such woody plants as produce in nature a single trunk, branching more or less above the ground."† Accepting this definition, there are included in the following list a few that are comparatively small, such as the Buffalo Berry and the Choke Cherry. But even these have the true tree habit and may properly be included.

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***Special attention is called to Bulletin No. 38 by Prof. B. C. Buffum, recently issued by this Station. That bulletin bears the title "The Cultivated Shade and Forest Trees," and considers in detail the characteristics and relative value of the various trees that are used on home and public grounds. Methods of transplanting and cultivating are also considered.**

**Since native trees must be so largely used for decorative purposes both on the home and public grounds it seems probable that a bulletin on how to recognize them may be welcome. For this reason this bulletin is made to follow so closely, in order that the two may supplement each other.**

†Bull. No. 14, U. S. Dept. of Agriculture, Div. of Forestry.

# KEY TO THE GENERA.*

§Leaves needle-shaped:
†In small bundles of two to five....................1. Pine (*Pinus*).
††Singly and with sharp points....................2. Spruce (*Picea*).
†††Singly and with blunt points.....3. Douglas Spruce (*Pseudotsuga*).
§§Leaves short, scale like.........................4. Juniper (*Juniperus*).
§§§Leaves with a true blade and stem (petiole):
†Fruit an egg shaped capsule, containing seeds furnished with a tuft of white, silky hair:
‡Buds resinous...................5. Cottonwood (*Populus*).
‡‡Buds not resinous......................6. Willow (*Salix*).
††Fruit a nut:
‡Small, in a close, cylindrical or oval cluster:
=Nutlet winged.................7. Birch (*Betula*).
= =Nutlet not winged..............8. Alder (*Alnus*).
‡‡Large, with a cup, singly or in clusters of 2 to 3.......
..............................9. Oak (*Quercus*).
†††Fruit with conspicuous wings:
‡Produced in pairs......................10. Maple (*Acer*).
‡‡Produced singly.......................11. Ash (*Fraxinus*).
††††Fruit fleshy, drupe like (Stone fruits):
‡Seed single, large, flattened ⎫ 12 ⎧ Plum ⎫ (*Prunus*).
‡‡Seed single, small, round ⎭ ⎩ Choke Cherry ⎭
†††††Fruit fleshy, a pome:
‡Seeds large for the fruit, bony.......13. Haw (*Crataegus*).
††††††Fruit fleshy, berry-like:
‡Seeds several, small.......14. Serviceberry (*Amelanchier*).
‡‡Seed single, large, pulp dry....15. Silver Berry (*Eleagnus*).
‡‡‡Seed single, small, pulp juicy......................
....................16. Buffalo Berry (*Lepargyraea*).

---

*The small number of genera and species of trees represented, it should be noted, does not indicate a scarcity of trees nor the absence of forests. It simply indicates that the climatic conditions on these high plains and mountain ranges are unsuited to any but the hardier forms. Scarcity of kinds does not mean scarcity of trees. One-sixth of the State or about 10,000,000 acres is more or less forest covered. Then too, what we lack in kinds of *trees* is more than made up to us in the wealth of species of *shrubs* and *herbaceous vegetation.*

# Pine Family.

(*Pinaceæ.*)

“ The pine is the mother of legends.”—*Lowell.*

This family of plants includes much the larger part of the forest trees of Wyoming. Those belonging in other families are either small and scattering or form merely fringes on the stream banks—scarcely, if ever, a solid body of timber. The Pine Family, though far from being confined to mountainous countries and cold climates, is peculiarly characteristic of such regions. The greatest development and largest number of species occur, however, where a moderately cool temperature is combined with an abundance of moisture, as is the case on some portions of the Pacific coast. Of the sixty species which become trees, credited to Northwest America, only eight are positively known to the writer as occurring within our bounds.

This family has for a long time been known as the Cone-Bearers (*Coniferæ*), since the fruit of most of its members is somewhat cone-shaped.

The cone consists of a number of spirally arranged scales on which the naked seeds are borne. All the trees of this group are more or less resinous and are all evergreen. The four following genera, with the species under each, constitute the tree-like representatives of this family in this state.

# 1. PINES.

(*Pinus.*)

> "Ancient pines,
> Ye bear no record of the years of man,
> Spring is your sole historian."—*Bayard Taylor.*

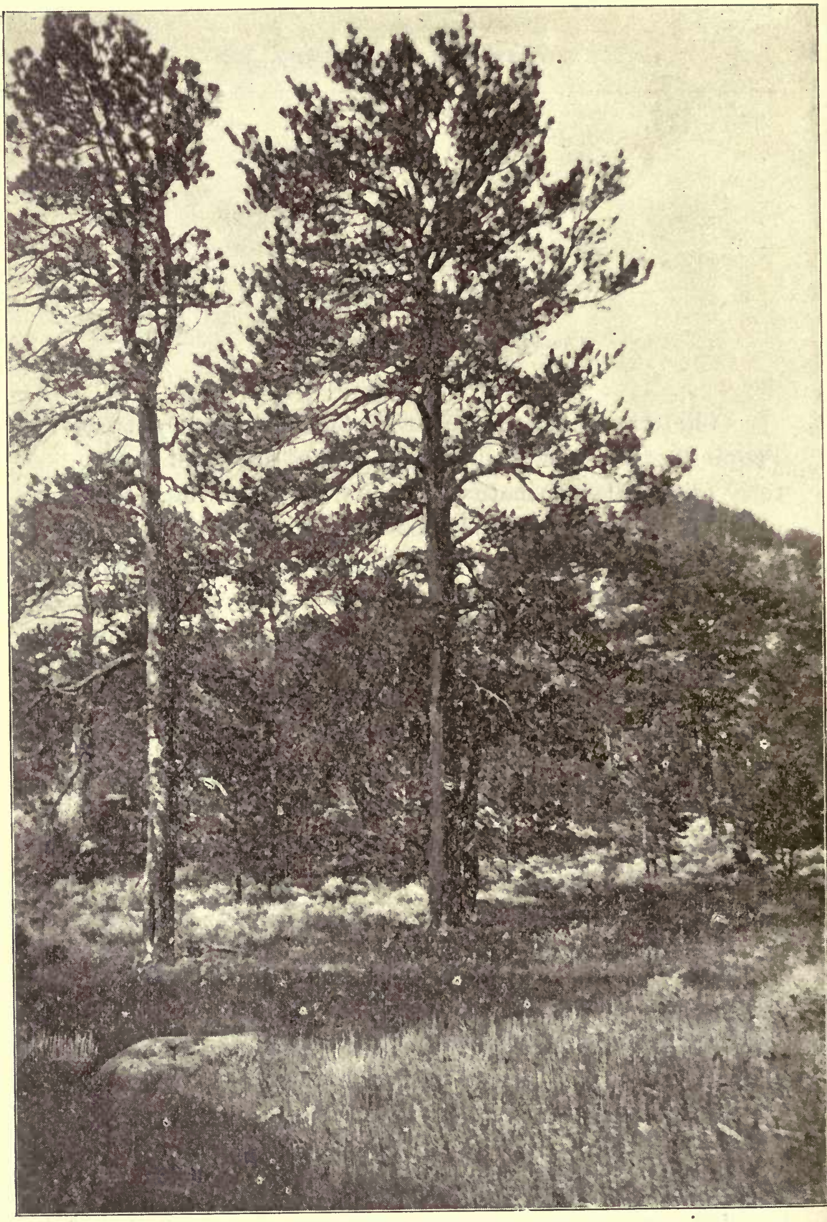
The term pine is by most people applied very loosely. People, ordinarily well informed upon other subjects, utterly fail to discriminate between the most widely different cone-bearing trees. To most they are all simply "beautiful pine trees," whether they are Pines, Spruces, Firs, or more widely divergent forms. Even Junipers are sometimes included in this convenient term. To separate them is so simple a matter that our attention need be called to only a very few facts to enable us all to call a pine a pine, and a spruce a spruce, the moment that we see them. That both of them belong to the Pine Family need not mislead us, for it is common practice to use in the name of a family of plants the name of the principal genus in that family. A family may have many genera with well marked characters.

HOW TO KNOW PINES.*—Leaves in bundles of two to five (see illustrations); cones rather large and heavy, scales tough and woody; seeds borne on the base of the scales.

Three species occur, as follows:

---

*Those who have occasion to use this Bulletin will please note that all statements and descriptions have reference to Wyoming trees. No effort has been made to discriminate except between our own species. The aim, ready reference, is best attained by few words. Full characterizations would hide the species in a mass of botanical terms.



IV. ROCK PINE. *Characteristic trees, 75 to 100 feet in height.*

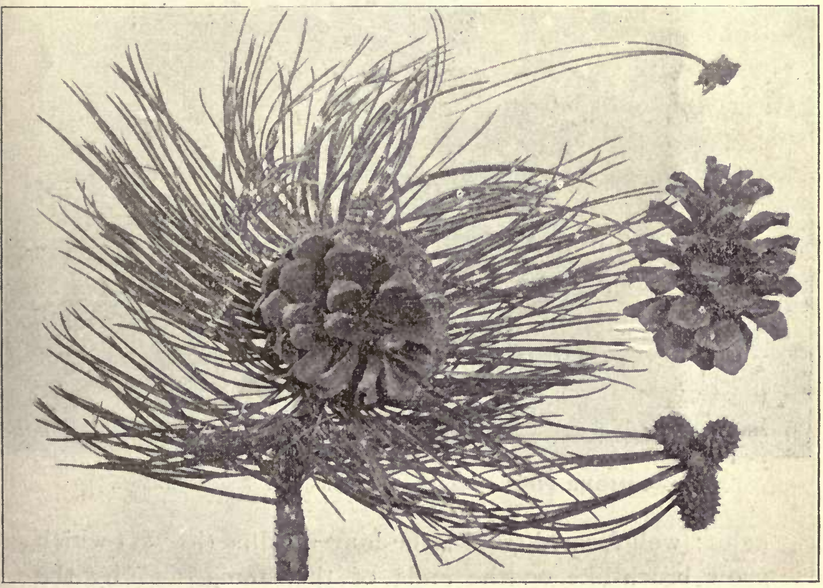
## (1) ROCK PINE.

(*Piuus scopulorum* (Engelm.) Lemmon).

"Under the Yellow Pines I house,
 When sunshine makes them all sweet scented,
An' hear among their furry boughs
 The baskin' west-wind purr contented."—*Lowell.*

**Description.**—Leaves in bundles of three (rarely two), 4 to 7 inches long, slightly rough on the margins; cone 3 to 5 inches long, scales much thickened at the outer end and bearing a sharp, recurved prickle.

This is one of the largest trees of this state, attaining a height of 75 to 125 feet and becoming 3 to 5 feet in diameter. In some localities, however, as at Pine Bluffs and in the Dakota Black Hills, only comparatively young trees seem to be present. It is probably the hardiest and most widely distributed, though not the most abundant.



**V. ROCK PINE.** *Young and old cones and leaf-bundle.*

It occurs in all of our mountain ranges from the foothills up to about 8,000 feet. The wood of this pine is heavy and resinous, with a handsome grain. It is used to a considerable extent for domestic and commercial purposes. The tree may always be known by its stout, usually erect habit; well formed trunk; the long needles (leaves) which grow brush-like on the ends of the stems, and by the thickened, spine-tipped scales of the heavy cones. The names we often hear, Pitch Pine and Yellow Pine, fail to distinguish it, for there are some others bearing these names.

**VI. LIMBER PINE.** *The Pine of the wind-swept slopes and hilltops.*

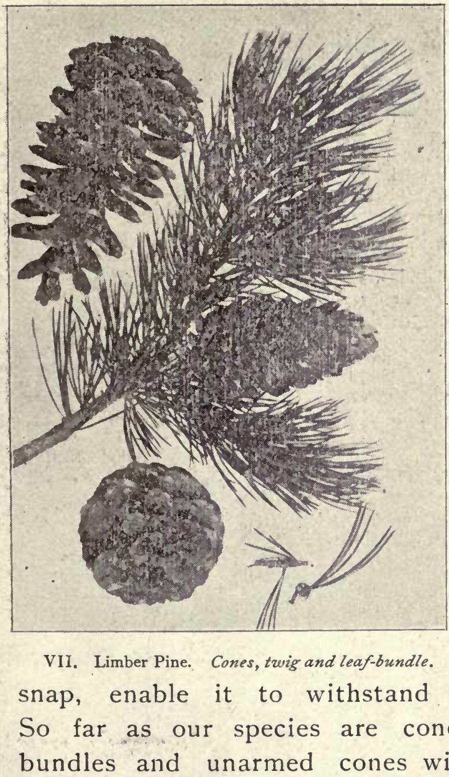
## (2) LIMBER PINE.

(*Pinus flexilis* James).

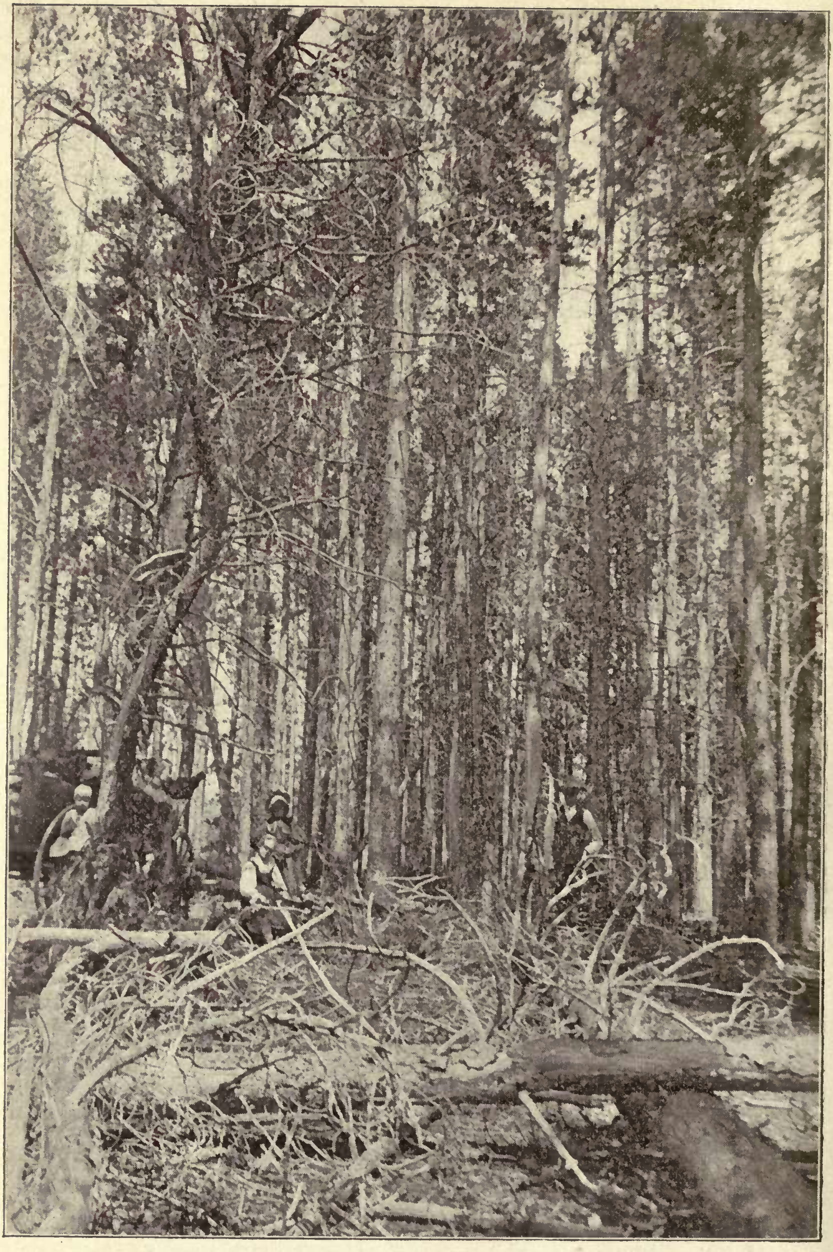
> "In winter, when the dismal rain
> Came down in slanting lines
> And Wind, that grand old harper, smote
> His thunder-harp of pines."—*Alex. Smith.*

**Description.**—Leaves five in a bundle, 1½ to 2½ inches long; cones light colored, long egg shaped, 3 to 4 inches, their scales with broad tips, not much thickened, widely spreading when mature.

Like the preceding, this is widely distributed and occurs in the hills and mountains in the most exposed situations. It forms a scattering growth or more rarely a continuous forest; is usually most abundant on east slopes, and is found at somewhat higher elevations than the preceding. It is rarely a well formed tree, except when it forms a dense forest, on account of the stress of weather that it has to endure in the exposed situations which it occupies. Its remarkably limber twigs, which no weight of winter snow can ever snap, enable it to withstand the fiercest tempest. So far as our species are concerned, the five-leaved bundles and unarmed cones will at once distinguish



VII. Limber Pine. *Cones, twig and leaf-bundle.*



VIII. LODGEPOLE PINE. *A characteristic forest of this species.*

it. It is largely used for fuel and possibly for other domestic purposes.

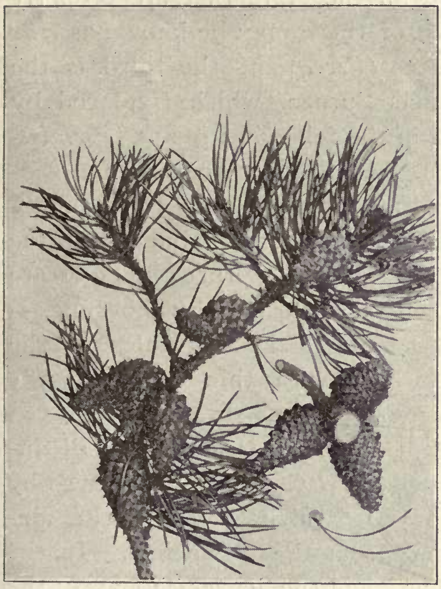
### (3) LODGEPOLE PINE.

(*Pinus Murrayana* "Oreg. Com.")

"Silent sea of pines."—*Coleridge*.

**Description.**—Leaves in bundles of two, about 2 inches long; cones small, reflexed, adhering tenaciously to the branches, which are often marked by the dead, persistent cones of the previous years; scales in the cone compact, the thickened, quadrangular ends tipped with delicate recurved prickles.

The most abundant of our pines. It usually occurs in large tracts as a dense forest and is found in all of our mountain ranges, especially on the moister slopes and where the winter snows are abundant. It prefers middle elevations, 6,000 to 9,000 feet. When growing in dense tracts it is exceedingly slender for its height and no doubt was formerly the source from which the Indian secured the light, slender poles for his wigwam. Poles 40 to 50 feet in length a man may very easily carry. When the trees are scattering they become less pole-like and attain a diameter of a foot or more. This species has furnished in Wyoming much the larger part of the poles for the miles and miles of fences. The



IX. Lodgepole Pine. *Cones, twig and leaf bundle.*

dead poles in a burned district can be prepared with little labor as they are nearly free from branches. Some lumber, railroad ties and much of the "lagging" for mines are obtained from this pine. This species is readily known by its slender habit; its persistent cones, and its paired leaves.

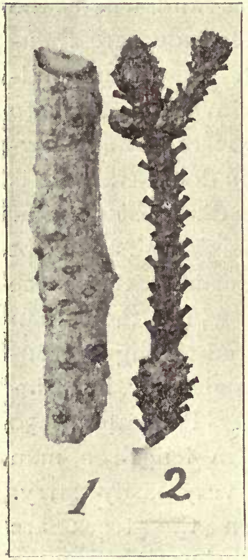
## 2. SPRUCE.

(*Picea.*)

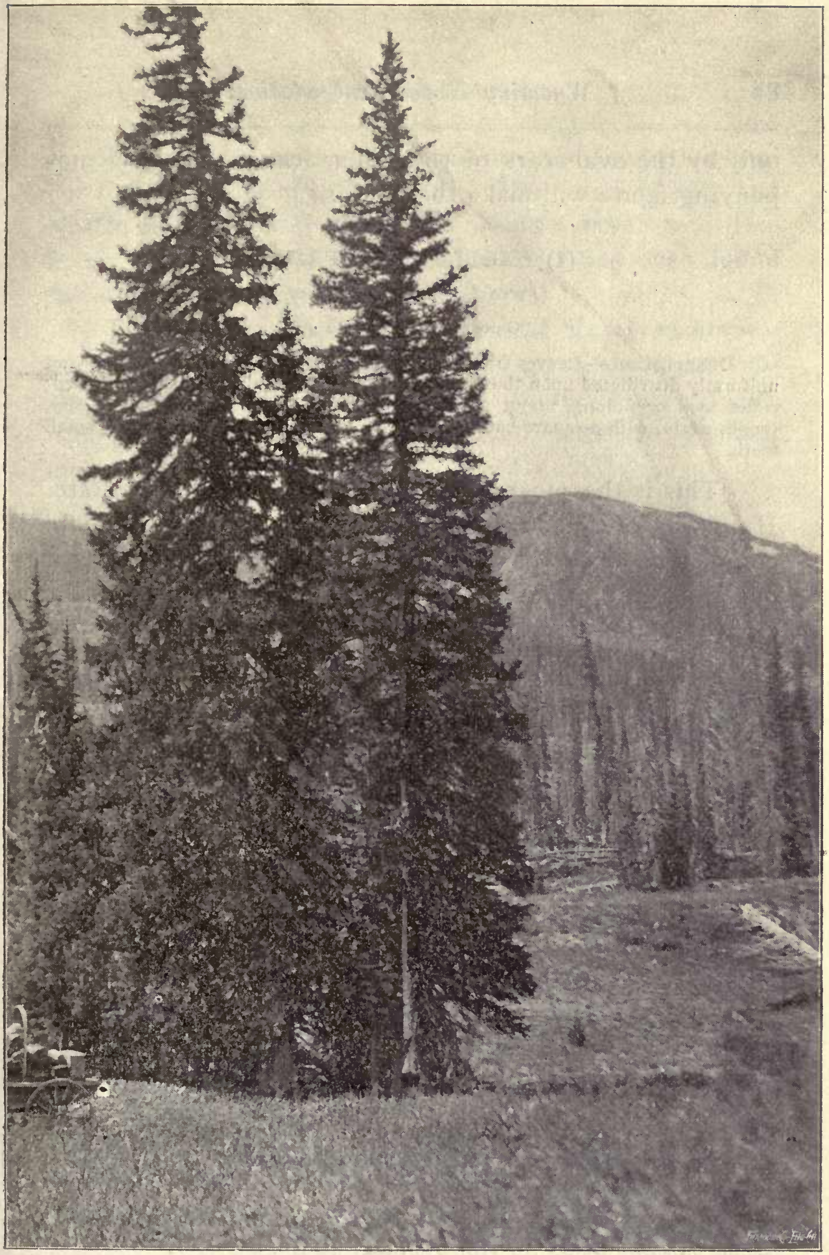
"This is the forest primeval."—*Longfellow.*

There are three trees in the state that are properly known as Spruces. Two of these may be known as *true* Spruces (*Picea*) and the third is the Douglas Spruce, which is placed by itself in the following genus (*Pseudotsuga*). All Spruces are at once separated from the Pines by the arrangement of the leaves—in bundles in the Pines, singly in Spruces. They are also easily separated by the cones—heavy with thickened scales in the Pines, light with thin scales in the Spruces.

The *true* Spruces are to be distinguished from the Douglas Spruce by the way in which the leaves are detached from the branchlets. In the former when the leaves fall away the branchlets are rough with the projecting, persistent leaf-bases; in the latter the branchlets are smooth, marked



X. Spruce twigs, showing the manner in which the leaves are detached.
*1. Douglas Spruce.*
*2. The true Spruces.*



XI. **ENGELMANN SPRUCE**. *Characteristic trees. This species often forms a close forest.*

only by the oval scars of the fallen leaves. The accompanying figure will make this plain.

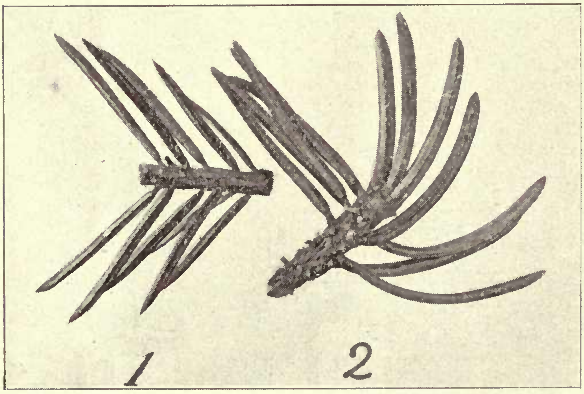
## (1) ENGELMANN SPRUCE.

(*Picea Engelmanni* Engelm.)

"Grove nods to grove."—*Pope.*

**Description.**—Leaves from ½ to 1 inch in length, singly and somewhat uniformly distributed upon the branches, four-angled, abruptly sharp pointed; cones oval or oblong, about 2 inches long and half as thick; scales thin, tough, ovate, with a square-cut tip which is entire or may bear a few small teeth.

This is the most important forest tree in the state. Hundreds of square miles in our higher mountains are completely clothed with it. Though not the largest of our trees, yet it attains in favorable situations a great size, becoming perhaps 100 feet in height and two feet or more in diameter. It is rarely found much below 9,000 feet and from that altitude up to timberline it is usually the only species. At the upper limit of trees it becomes merely a spreading, prostrate shrub, buried for months beneath the load of the winter snows. These are strikingly different in appearance from the tall, spire-shaped trees on the lower slopes.



XII. Leaves of the true Spruces. *1. Blue.* *2. Engelmann.*

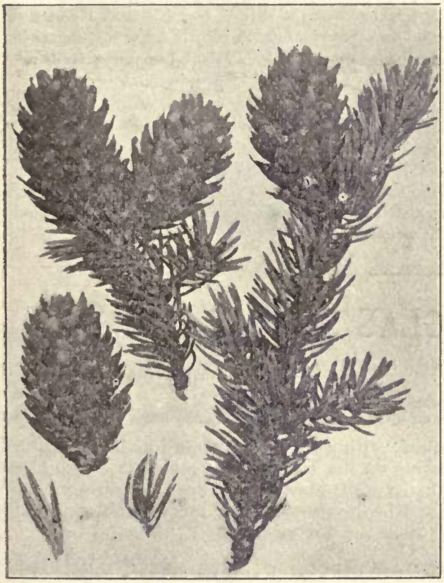
From this species is obtained much of the native lumber that is produced in the state. The wood is firm and elastic and while it is difficult to obtain lumber free from knots, yet since these rarely fall out, it has been found suitable for a large number of purposes.

This is the species that the Forest Reserves are especially designed to protect. These great tracts of subalpine woods hold back the waters of the winter snows, from which the streams are fed late into the summer months.

### (2) BLUE SPRUCE.

(*Picea pungens* Engelm.)

"No tree in all the grove but has its charms,
Though each its hue peculiar."—*Cowper*.



XIII. Blue Spruce. *Twigs and cones.*

**Description.**—Leaves very similar to the preceding, more slender and rigid, more strongly 4-angled and sharper pointed, often with a blue-green (glaucus) color; cones also quite similar (reddish-brown in both), longer and more cylindrical in this, scales very thin and usually with a wavy, irregular edge.

The Blue Spruce, while widely distributed throughout the Rocky Mountains, cannot be said to be abundant. It occurs at intervals throughout our mountains, mostly as scattering individuals or in small clumps. It is found at middle elevations, rarely reaching 9,000 feet, and prefers moist soil. Near streams and on moist slopes it makes a fair-sized tree, but the wood is said to have little value.

It is not readily distinguished from the preceding except by its habitat, its usually smaller size, its cone-shaped habit, i. e., its sharply tapering crown, and its blue-green or silvery foliage.

On account of its handsome appearance it is largely used as an ornamental tree for planting on the home or public grounds.* Most of the trees thus used are nursery grown, as they transplant more readily than those removed directly from their mountain habitat.

There is a probability that Wyoming possesses one of the true Fir trees. Though the writer has not found it, he has no reason for thinking that the species that has been reported a few times from our higher mountains is not here. Sometimes such reports arise from mistaken identity, but in this case it will be rather surprising if the presence of the following species is not established:

**ALPINE FIR** (*Abies lasiocarpa* (Hook.) Nutt.) A slender tree of the higher mountains of the western United States. Its leaves, like those of the Spruce, are borne singly, somewhat in two ranks: the branches are arranged in a succession of whorls: the cones are nearly cylindrical, about 2½ inches long, erect and produced at the sides of the branches: bark thin and pale. If any of the users of this bulletin happen to find this tree, the foregoing statements will aid in distinguishing it from the Spruces, the only trees in this state with which this Fir could be confused. Reports concerning it will be welcome.

## 3. DOUGLAS SPRUCE.

(*Pseudotsuga taxifolia* (Lam.) Britt.)

> "Oh! proudly then the forest kings
> Their banners lift o'er vale and mount."—*Edith May*.

**Description.**—Leaves flattened, with a narrowed, stem-like base, mostly blunt pointed, whitish below, twisting on the base so as to appear comb-like on the branches, ¾ in. to twice that length: cones egg shaped, about 3 inches long and half as thick; three pointed bracts project from among the scales of the cone: bark, in old trees, very thick and furrowed.

This is one of the largest trees of the state and for that matter of the United States. It reaches its maximum size in moister climates, but even here it is a stately tree, often much exceeding a hundred feet in height. It occurs in canons and on rocky slopes up to 10,000 feet, the finest specimens being found near the banks of mountain streamlets. Its wood is hard and durable, making it of much value where heavy timbers are required. Much lumber is made from it and for railroad ties it is considered superior.

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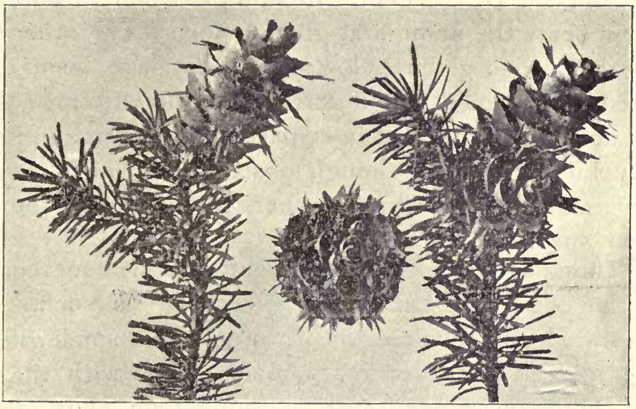
*See Bull. 38 of this Station by Prof. B. C. Buffum.



XV. Douglas Spruce. *Twigs and mature cones.*

It may always be distinguished from the true Spruces by its blunt leaves, its thick, furrowed bark, and especially by the cones. These, with their three-pointed bracts, are quite peculiar to this tree.

## 4. JUNIPERS.

(*Juniperus.*)

"Thus yields the cedar to the axe's edge,
Whose arms gave shelter to the princely eagle."—*Henry VI.*

The members of this genus are often known as *cedars*, but this name properly belongs to another genus, while this group should always be called *Juniper*. Of the twelve tree-like Junipers in the United States, Wyoming has two, both of which have recently been described as new. One of these has been known for years as occurring here, but has been supposed to be the same as the Red Juniper of the eastern states. It was only in 1897 that the distinctions between the two were made out, in part from a series of specimens prepared at the University of Wyoming for Dr. Sargent, Director of Arnold Arboretum. It now bears the name first given below. The other species, the second given below, seems to have been overlooked until named and described by the writer in 1898. This does not mean that it is particularly scarce in its locality but only that, though observed by many, it had been assumed, as with the other, to be one of the well known species.

Though the Junipers are included in the cone-bearers yet the cone will hardly be recognized as such. The scales are small, few and fleshy and form a small globose berry instead of the ordinary cone. This, with the fact that the leaves* are scarcely more than short, fleshy scales, will enable anyone to at once recognize these evergreen trees, our two species of which it will not be hard to separate.

### (1) ROCKY MOUNTAIN JUNIPER.

(*Juniperus scopulorum* Sargent).

"Will these moss'd trees,
That have outliv'd the eagle, page thy heels,
And skip when thou point'st out?"—*Shakespeare.*

**Description.**—Leaves in pairs, very short, nearly clothing the branchlets: berries very numerous, not maturing until the close of the second season, light green when young, when mature blue with a whitish bloom.

This species is found at intervals throughout the

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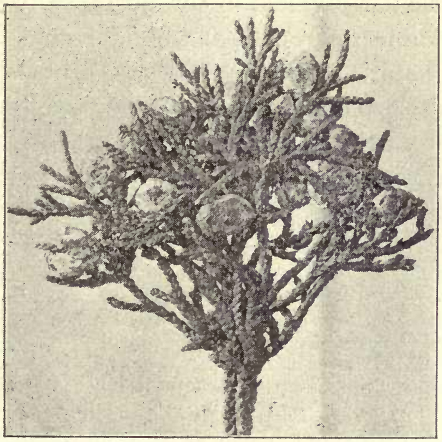
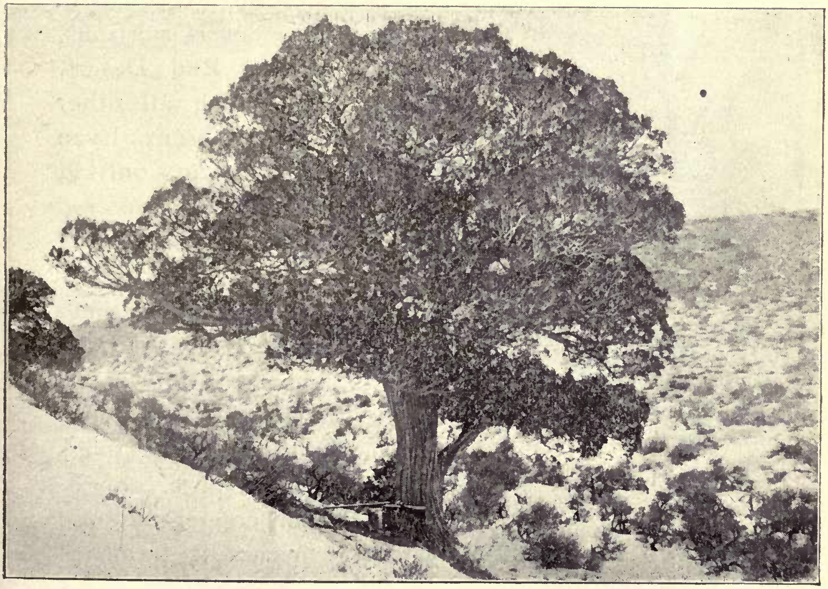
*In very young plants the leaves are usually longer, needle or awl shaped, sometimes ½ inch in length.



XVI. Rocky Mountain Juniper. *The tip of a branch, showing berries.*

state from the southeastern to the northwestern corner. It occurs in canons and on rocky bluffs. Often it is stunted and shrub-like but more often a tree with short, thick trunk and rounded top. Sometimes it branches from the base and then resembles in habit the following species. Its wood, though occasion-



**XVII. ROCKY MOUNTAIN JUNIPER.** *Usual form, but often more shrubby and branched from the base.*

ally used for fuel, is particularly valuable for posts, as it resists decay to a remarkable degree even when in contact with the soil. Its habit, its numerous small, blue berries, which have a whitish bloom, and its slender twigs will serve to separate it from the next.

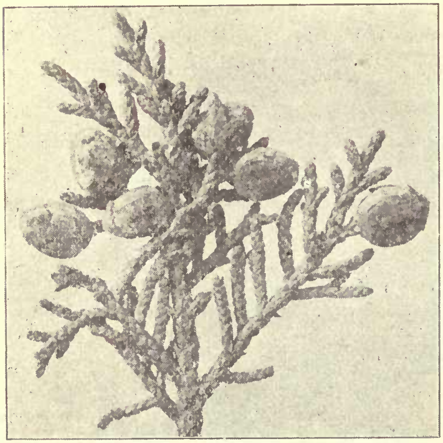
### (2) DESERT JUNIPER.

(*Juniperus Knighti* Aven Nelson)

> "The century-living crow,
> Whose birth was in their tops. grew old and died
> Among their branches."—*Bryant.*

**Description.**—Branched from the base, rarely with a single trunk, usually a rounded, bushy clump of sub-equal trunks and spreading branches, 10 to 30 feet high: leaves three-ranked, thick, about 1-12 inch long; berry blue-green or copper-colored, marked on the surface by more or less projecting points: seed single (rarely two), large, covered by the dry pulp.

So far as the distribution of this tree is known it is confined to the south-central and the southwestern part of the state. It occurs in those desert portions, like the Red Desert, from which all other trees are absent. Even here it occurs only at intervals on the red sandstone hills and bluffs as scattering individuals or sometimes forming considerable thickets. It will be known by its bushy habit, its thick twigs and its large, roughened, copper-colored berries. In the localities where it occurs it furnishes fence posts and fuel.



XVIII. Desert Juniper. *The tip of a branch, showing berries.*

**XIX. DESERT JUNIPER.** *Typical specimens of this species.*

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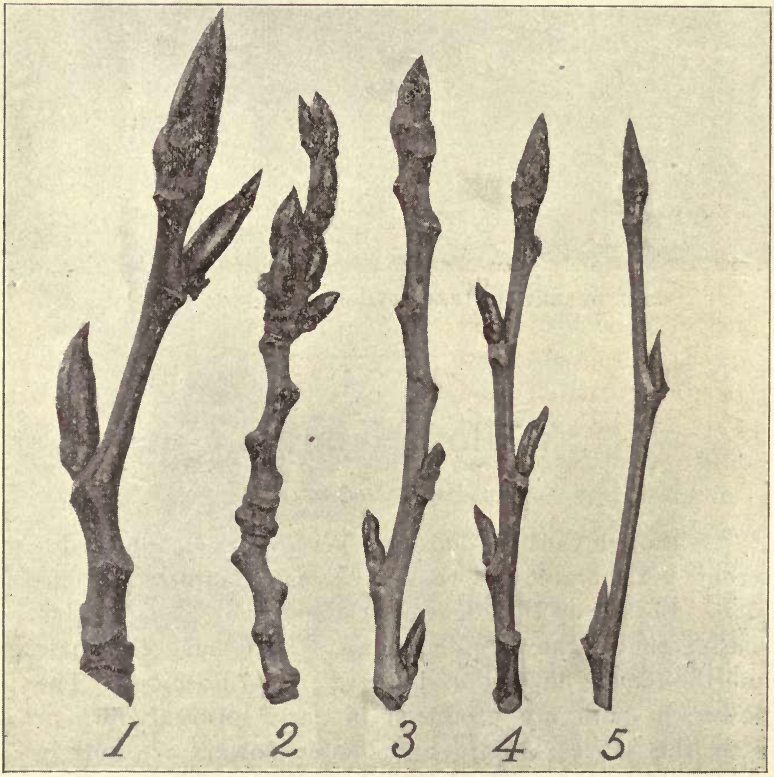
# Willow Family.

(*Salicaceæ*)

Although Cottonwoods and Willows seem quite different, yet, botanically, they have many features in common. Both drop their leaves at the end of the growing season, that is they are deciduous. Both have the male and the female flowers on different trees (dioecious). The flowers in both are produced in early spring, before or with the leaves. Male and female flowers are both in slender clusters or tassels known as *aments* or *catkins* (the "pussies" of the children). These are usually drooping in our Cottonwoods but mostly erect in the Willows. The female flower cluster develops into a somewhat similar but more elongated cluster of capsule-like fruits, which are two-celled and contain several small seeds that are furnished with a tuft of fine hairs. When mature these are readily borne for miles by the wind, but only a very small percentage are ever lodged in a suitable place for germination and development.



**XX. COTTONWOODS.** *Twigs showing characteristic winter buds. 1. Balm of Gilead. 2. Aspen. 3. (Common) Cottonwood. 4. Lanceleaf Cottonwood. 5. Narrowleaf Cottonwood.*

# 5. COTTONWOOD.

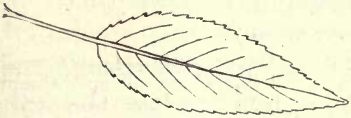
(*Populus*)

"He that plants trees loves others beside himself."

The Cottonwoods need no description as a group. They are known to everyone, but it may not be perfectly clear that the Aspen and the Balm of Gilead are Cottonwoods. In fact we shall not call them by that "common name," but they as well as the other three belong in the genus *Populus*. Our five species are easily known in the summer time by the shapes of the leaves, as shown in the figures accompanying the short descriptions below. Since these are the trees that we must use to a large extent for shade and ornamental planting* in this state, it is desirable that we be able to recognize them in their winter condition also. Transplanting can most safely be done in the spring before the buds open. To assist in recognizing them at that time the accompanying plate, showing a twig and buds of each, will be helpful, as will also a study of the bark character.

## (1) NARROWLEAF COTTONWOOD.

(*Populus angustifolia* James)



**Description.**—Leaves small, oblong or lance-shaped, usually acute at the apex and with rounded base, finely scalloped on the margins: buds small, pointed, dark brown (see Plate XX, Fig. 5): bark thick, coarsely furrowed and dark colored, these characters more pronounced as the tree grows older.

The most abundant of the Cottonwoods (excepting the Aspen) in this state. It becomes in some localities a large tree, sometimes 75 feet high and 3 feet in diameter, though usually it is much smaller. It occurs at intervals on all the larger streams in the state either as a fringe on their borders or in groves quite covering the adjacent low bottom lands. It may always be known by the small, narrow leaves and the dark, thickened, furrowed bark which becomes enormously thickened in the old trees.

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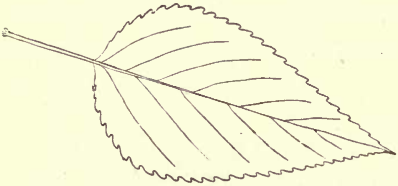
*See Bull. 38 of this Station.

### (2) LANCELEAF COTTONWOOD.

(*Populus acuminata* Rydb.)

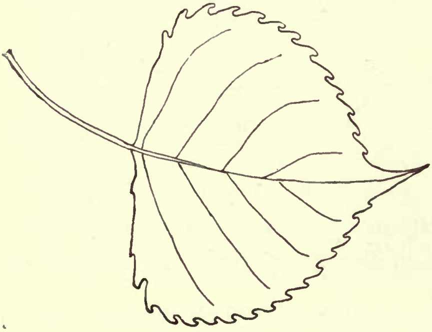


**Description.**—Leaves broadly lance-shaped or ovate, apex acuminate, finely scalloped on the margins, larger than in the foregoing species, 2 to 3 inches long (on young shoots often more): buds medium sized, light brown (see Plate XX, Fig. 4): twigs slender, light colored: bark in young trees very smooth and almost white, becoming darker and rougher as the trees get older but never so much so as in the preceding species.

Though found native in the state it is far from common and, so far as the writer's observation goes, occurs very sparingly on only a few tributaries of the Platte in the eastern part of the state. That it occurs elsewhere within our borders is, however, quite probable. It attains nearly as great a size as the preceding but is a smoother, handsomer tree at all times. It makes a more rapid growth, is a trifle less hardy but is used largely for planting—mostly from nursery stock.

### (3) COTTONWOOD.

(*Populus deltoides* Marsh.)



**Description.**—Leaves broad, deltoid-ovate, the apex abruptly pointed, the base nearly truncate, rather coarsely scalloped or toothed on the margin: buds larger than in the preceding (see Plate XX, Fig 3): the youngest branchlets angled: bark grayish, becoming rough and irregularly furrowed as the tree gets older.

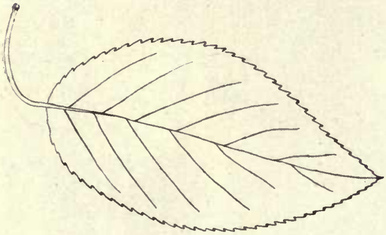
This is the (common) Cottonwood of

the eastern and central United States. Throughout that region it is very abundant but it just comes into our range on the eastern border of the state. On the Platte and its tributaries and in Crook and Weston counties it is known to occur. It is the largest of the Cottonwoods and may easily be known by its leaves and the "necklace-like" fruits as well as by the bark which is roughened by oblique furrows, and is nearly uniform in color throughout.

Like the preceding it is used to some extent for fuel and other domestic purposes but the wood is soft and weak and not very highly valued.

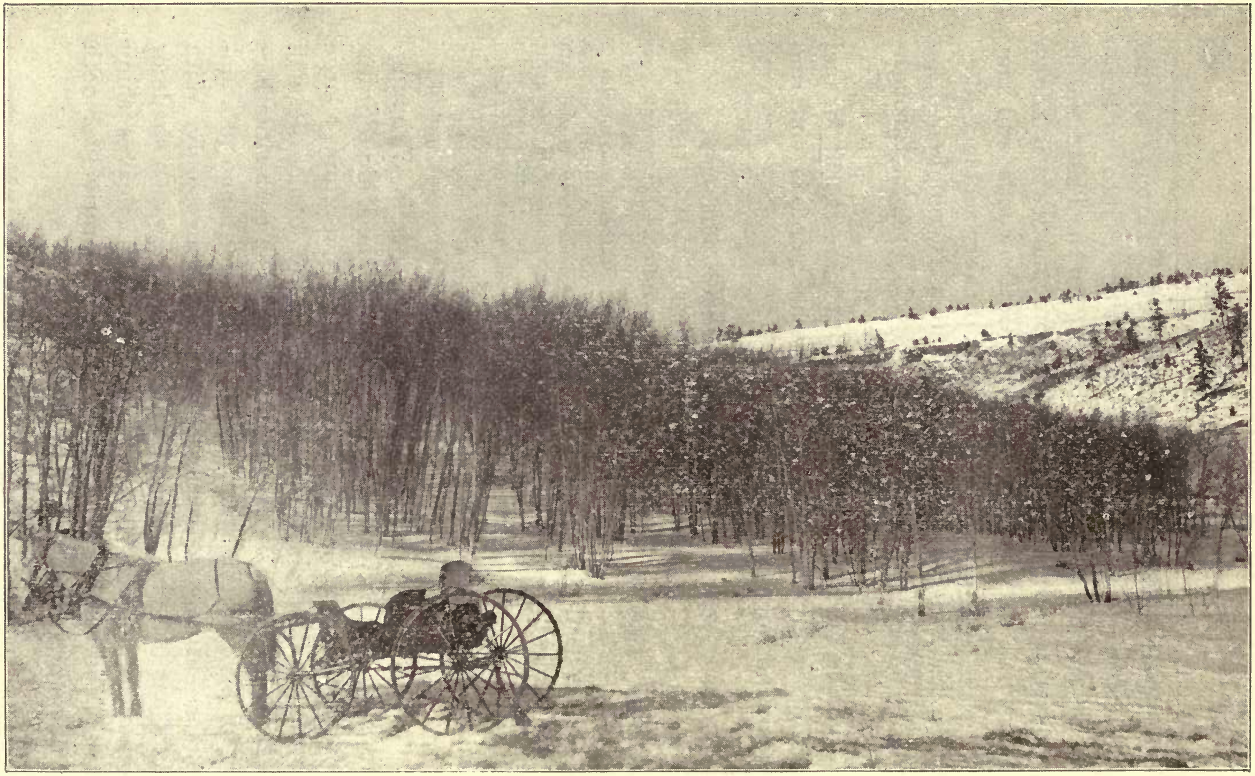
### (4) BALM OF GILEAD.

(*Populus balsamifera* Linn.)



**Description.**—Leaves ovate, tapering gradually to the acute apex, smooth and green above, whitish beneath, finely scalloped on the margins: buds large, coated with resinous, glutinous gum (see Plate XX, Fig. 1): bark smooth on young trees, somewhat roughened on the old, darker in color than in the Lanceleaf Cottonwood which also has nearly smooth bark.

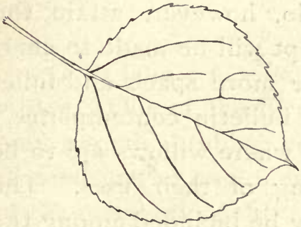
This species is of rather rare occurence in Wyoming. Its range is eastward and northward in the United States and Canada where, in favorable situations, it attains a large size. It seeks sheltered localities on the banks of small lakes and streams. It may be expected in such situations in all parts of this state, though it is never found in abundance—usually scattering trees or small groves only. With us it has little economic importance except as a shade or ornamental tree. Its large resinous buds, leaves shiny above and whitish beneath, and bark comparatively smooth will enable anyone to know this tree.



XXI. AN ASPEN GROVE. *Characteristic location among the hills.*

### (5) ASPEN.

(*Populus tremuloides* Michx.)



**Description.**—Leaves small, broadly ovate or rounded, abruptly short pointed, finely toothed on the margins, leafstalks flattened latterally causing them to tremble in the slightest breeze: buds short and thickened (see Plate XX, Fig. 2): somewhat crowded at the ends of the twigs: bark smooth except in very old trees.

Found in abundance in those parts of the state where hills or mountains abound. It occurs as thickets or groves on the slopes where snowdrifts form and on the banks of mountain streams. Our illustration shows a characteristic location and a typical Aspen grove. The trees are usually small but in very favorable situations may attain a height of 50 feet or more.

The long, slender, pole-like trunks are used more or less for fencing, and as fuel are not to be despised. Transplanted from the grove and set out singly they grow but slowly and never form shapely trees.

## 6. WILLOW.

(*Salix*)

Perhaps no other state in the United States possesses so many different kinds of willows as Wyoming. Mr. M. S. Bebb (now deceased), the greatest authority on willows in recent times, in a letter to the writer a few years since emphasized "Willow State" as a suitable name for Wyoming. In spite of the large number of species found within our borders we have very few that attain tree-like size. Most of them are mere shrubs, forming great thickets on the borders of our mountain brooks and swamps and fringes on the banks of the larger streams. The few merely named below do, however, attain the stature of small trees. No attempt will be made to characterize these as it would require more space and fuller botanical descriptions than this bulletin contemplates.* Everyone knows a willow, knows where willows are to be sought and knows, too, something of their uses. The following are the species that may be included among the trees of the state:

### (1) ALMONDLEAF WILLOW.

(*Salix amygdaloides* Anders.)

One of our largest and most widely distributed tree-like willows. It is generally spoken of simply as the "common willow."

### (2) WESTERN BLACK WILLOW.

(*Salix lasiandra* Benth.)

The Wyoming form of this willow is considered only a variety (var. *caudata*) of the species as written above. It ranks with the preceding in size and is widely distribted in the state.

### (3) BEBB WILLOW.

(*Salix Bebbiana* Sargent)

Though never large it is decidedly tree-like on account of its usually single trunk and rounded bushy top.

It seems doubtful whether any of the other numerous species attain such a size as to be called trees.

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*Possibly sometime in the future it may seem of sufficient importance to issue a special bulletin on our Willows and their uses. The entire list and the means of recognizing them may then be given.

# Birch Family.

(*Betulaceæ*)

This family is represented by three Birches and one Alder. One of the Birches (*Betula glandulosa* Michx.) is only a small shrub occurring in swales in the mountains, so need not be mentioned further in this bulletin. None of the members of this family become very large in Wyoming, but they are to be recognized as true trees. No lengthy description is necessary, for there are no trees in the state with which they can be confused. As in the Willow Family, the flowers are borne in separate clusters, but in this on the same plant, while in the Willows they are on separate plants. The male flowers are in slender, drooping clusters, while the female form shorter, thicker and erect aments. The numerous fruits in the cluster, when ripe, are small, flattened, one-seeded nutlets with a small, thin wing at either side.

## 7. BIRCH.

(*Betula*)

Our Birches are slender trees with slender, limber branches and rather small leaves; the seed-like nutlets distinctly winged. The two species are easily separated by the bark alone.

### (1) PAPER BIRCH.

(*Betula papyrifera* Marsh)

**Description.**—Bark white, smooth, on young branches often with numerous dots, peeling readily into thin, paper-like layers, hence the name: leaves ovate, small, toothed on the margins.

This species in northern and eastern America be-

XXII. Paper Birch. *Leaf and fruit cluster* (*ament*).

comes quite a large tree. Since its bark was the source of the Indian's canoe it is sometimes called the "canoe birch." Since it has also often furnished the material upon which letters were written, it has always been of much interest. It is very rare in Wyoming, probably occurring only in the northeastern part, in the Black Hills. Here fine specimens of it are not rare, though they seldom attain any great size.

### (2) WESTERN BIRCH.

(*Betula occidentalis* Hook.)

**Description.**—Bark smooth, dark or bronze-colored: branches resin dotted: leaves ovate or sometimes nearly round, sharply toothed, rather small and thin: the very small, seed-like nut with broad wings.

This birch occurs on many of our mountain streams, usually as a mere fringe on the banks but occasionally as small thickets. It attains a height of 25 to 40 feet and furnishes slender poles often used for fencing as well as for fuel. It need never be confused with the preceding, but is less readily distinguished from the following.

## 8. ALDER.

(*Alnus*)

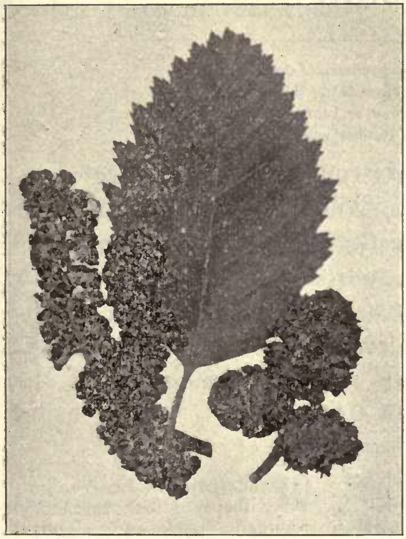
This genus is represented by one species only, and since it is of small economic value it may be treated briefly.

### (1) PAPERLEAF ALDER.

(*Alnus tenuifolia* Nutt.)

**Description.**—Leaves rather large, sharply double-toothed: flowers in clustered aments, developing during the summer preceding the season in which they open and hanging naked upon the branches during the winter, opening in the spring before the leaves develop: seed-like nutlet slightly margined but scarcely winged.

This is little more than a large shrub, but since it occurs so extensively throughout the state and lends itself so readily to transplanting it seems well to include it. It usually forms clumps of several or numerous stems from the root and grows as an overhanging fringe on the banks of mountain streamlets. Its habit of growth and the presence in winter of the naked flower clusters will help to separate it from the Western Birch, the only species with which it can be confused. It has some fuel value and often constitutes natural windbreaks that are of service to ranch homes and to stock on the range. It can be used effectively for ornamenting the home grounds.



XXIII. Paperleaf Alder. *Leaf, male flower cluster (left) and fruiting cluster.*

# Beech Family.

*(Fagaceæ)*

Because of similar botanical characteristics the Oak genus (*Quercus*) is placed in the above family. Since for our present purposes we are concerned with a single species of Oak, we need not consume space in describing this family. but may pass at once to the genus.

## 9. OAK.

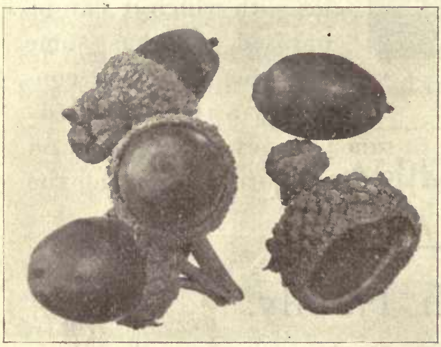
(*Quercus*)

> "The monarch oak, the patriarch of the trees,
> Shoots rising up, and spreads by slow degrees:
> Three centuries he grows, and three he stays
> Supreme in state, and in three more decays."—*Dryden.*

The Oaks belong to that group of trees that are often spoken of as "hardwoods." While the quality of the wood in the several species differs greatly, yet all furnish timber of much value. As sources of lumber for furniture, implements, machinery and for all sorts of timbers where great strength is required this group holds an important place.

### (1) BUR OAK.

(*Quercus macrocarpa* Michx.)



XXIV. Bur Oak. *Acorns and cups.*

**Description.**—Leaves obovate, deeply lobed, the lobes rounded, pale and slightly downy beneath: nut at first wholly enclosed in the cup, becoming rather large and at maturity usually less than half enclosed: the scales of the cup conspicuous.

This species has a wide range in North America and in favorable situations becomes a very large tree. Like most oaks, it thrives only at low altitudes. On that account it is something of a surprise to find it in Wyoming at all. It is, however, quite abundant among the hills in the lowest portions of Crook County. In such situations it is usually much reduced in size, but here in some places it is not only well represented but many specimens become fine trees 2 to 3 feet in diameter. It is one of the valuable timber trees of that county.

## Maple Family.

### (*Aceraceæ*)

The Maple Family has three representatives, all of them small, the Box Elder being the largest of the three. The Silver, or Soft, Maple, so largely used as a shade tree in the states lying to the east of this, does not occur here and will not endure the climate of many parts of this state. The species that do occur are all much hardier, but are shrubby in habit and less well adapted for transplanting.

## 10. MAPLE.

### (*Acer*)

This is the only genus in this family in North America. All its members are trees or shrubs with watery or sweetish sap, the seed-like fruit in pairs and conspicuously winged. Our species are as follows:

### (1) DWARF MAPLE.

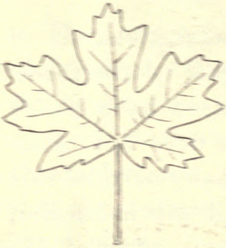
(*Acer glabrum* Torr.)

**Description.**—Leaves 1 to 2 inches long, smooth or nearly so on both sides, lobed, the lobes acute and sharply toothed: the winged seeds about 1 inch long.

This species is common in the foothills and the more broken areas of the state. It prefers canons and canon sides where it is hardly more than a shrub, growing in clumps of larger or smaller size. More rarely it becomes a small tree 20 to 30 feet high. It may always be recognized by its paired (opposite) buds, sharply lobed leaves, light colored bark and the paired wing-fruits. A clump or two of it on the home grounds would add much to the interest of the surroundings.

### (2) LARGE-TOOTH MAPLE.

(*Acer grandidentatum* Nutt.)

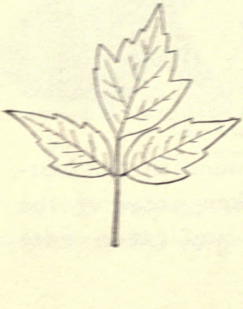


**Description.**—Leaves 3-lobed, the notches rounded and the lobes wavy-toothed, larger than in the preceding: seeds as in the foregoing but slightly smaller and with narrower wing.

This Maple belongs west of our range but it occurs sparsely in the southwestern part of the state and possibly along our whole western border. It is nearly related to the Sugar Maple but being small and scattering its sap is not utilized. In rare instances the trees become 35 to 40 feet high and a foot in diameter. The sketch of the leaf shows the characters that easily separate this leaf from that of the preceding. With leaf and seeds (even young ones) in hand there can be no mistaking this for any of our other trees.

### (3) BOX ELDER.

(*Acer negundo* Linn.)



**Description.**—Leaves compound, i. e. 3 to 5 leaflets (as shown in figure) on each leafstalk, pubescent when young, smooth when old, few toothed or rarely somewhat lobed: wing-fruits paired and very similar to the preceding Maples but broader and finely veined.

We do not always think of the Box Elder as a Maple but its fruit and floral characters show that it is very closely related to the others. It is fairly plentiful throughout the entire eastern part of the state along the streams. Its habit is always tree-like but it rarely attains a great size—25 to 40 feet in height and a foot in diameter being probably the maximum. It is hardy and may be readily transplanted though in higher portions of the state it makes slow growth and may need some protection. Its fruits, its leaves and the slender, drooping clusters of greenish flowers make it easily recognizable.

## Olive Family.

(*Oleaceæ.*)

This family contains about a score of genera only a few of which belong to North America. Of these the common Lilac (*Syringa*) and the Ash (*Fraxinus*) are the best known. Since the members of this family differ greatly among themselves, our species only need be considered.

## 11. ASH.

(*Fraxinus.*)

Of the dozen or more species in the United States, one (possibly two) occurs in Wyoming. All are trees and some of them attain a great size, furnishing timber of much value. They are easily known by the compound leaves and the winged fruits as shown in the figure below. The fruits are borne in clusters and do not differ materially except in the relative size of the wing and the body of the seed.

### (1) GREEN ASH.*

(*Fraxinus lanceolatus* Borkh.)

**Description.**—Leaflets 5–9, finely toothed on the margins, long pointed, green on both sides: male and female flowers on different trees, in a close cluster, appearing with or before the leaves: fruits about 1¼ inches long.

This species appears but sparingly in this state, only so far as known on some of the streams in the eastern part, though probably it occurs northward in the lowest portions of the state as well. Its wood is valuable but the trees with us are too small and scattering to have any economic importance except as it may be used as a shade or ornamental tree.

## Plum Family.

(*Drupaceæ.*)

This family is represented by the common Wild Plum and one species of Choke Cherry. As is well known these trees are all small, all have a fleshy fruit with a single stone-like seed.

## PLUM AND CHERRY.

(*Prunus.*)

Here belong Plums and Cherries of all kinds, too well known to need any description. Our species are as follows:

---

*There is a possibility that in the Black Hills of Crook County some specimens of the Red Ash (*Fraxinus Pennsylvanica* Marsh) may be found. Though it rather closely resembles the Green Ash yet it may be known by the leaves being pale and soft, or velvety, hairy below and the body of the seed being about as long as the wing.

### (1) WILD PLUM.

(*Prunus Americana* Marsh)

**Description.**—Leaves ovate, pointed, sharply toothed, smooth when old: fruit globose, red or yellowish; seed flattened.

This small tree occurs with more or less frequency in the northeastern counties and yields occasionally a considerable amount of its pleasantly acid fruit. It is well worthy of cultivation for not only does it yield better fruit and more of it, when the tree is cared for, but it is at the same time a desirable addition to the trees of the home grounds, because of its wealth of white flowers.

### (2) WESTERN CHOKE CHERRY.

(*Prunus demissa* (Nutt) Walp.)

**Description.**—Leaves ovate, acute, finely serrate: the white flowers in dense, cylindrical clusters: fruit when ripe nearly black.

In most localities this is only a small shrub but in very favorable situations it becomes a tree 20 or more feet high. The handsome, clustered flowers and fruit ought to give it more extended use in ornamenting the home grounds. From the fruit may be made a superior jelly, especially when mixed with other native fruits such as the Barberry or Buffalo Berry.

## Apple Family.

(*Pomaceæ*)

Of the several genera in this family we need to notice but two. These in common with the others have a fleshy fruit formed by the thickened calyx tube which encloses the seed vessels.

## 13. HAW.

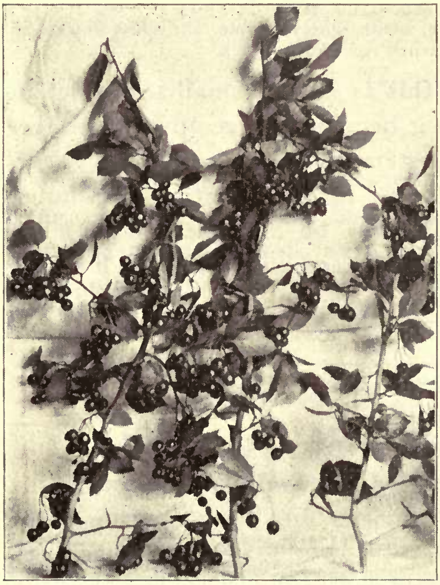
(*Cratægus*)

> "Gives not the hawthorn bush a sweeter shade
> To shepherds, looking on their silly sheep,
> Than doth a rich embroidered canopy
> To kings, that fear their subjects treachery."—*Henry VI.*

The Haw, or Hawthorn as it is often called, includes several species of small trees, mostly with short, well formed trunks, a rounded bushy top and more or less thorny or spiny branches. The small, edible, apple-like fruit with its large, bony seeds well distinguishes this genus.

### (1) BLACK HAW.

(*Cratægus Douglasii rivularis* Sargent)



XXV.—Black Haw.

**Description.**—Leaves narrowly to broadly ovate, irregularly sharply toothed, mostly green and smooth above, paler beneath: fruit black when ripe, about ⅜ of an inch in diameter: thorns stout, an inch (more or less) in length.

A small tree of fine appearance, well worthy of cultivation. Its wealth of flowers in May or June, according to altitude, and its abundant clusters of fruit which remain on the tree for a long time make it an object of much interest. There are two forms of this in the state which differ slightly in leaf form but prbably in no essential character. It occurs on most of the larger streams of the state, and may be at once separated from the next by its black fruit.

### (2) LONGSPINE HAW.

(*Crataegus macracantha* (Lindl.) Loud.)

**Description.**—Leaves sharply double-toothed, dark green, smooth above, slightly hairy on the veins beneath: calyx glandular: fruit globose, about ⅜ of an inch in diameter, red when ripe.

This species is more shrub-like and with more straggling branches but it is equally desirable for home planting. Its wealth of white blossoms and its red fruit make it an attractive shrub or tree. While the fruit has no great value yet of the two this is probably superior to that of the preceding. This species is not known to the writer as occurring in this state outside of Crook county but it probably exists elsewhere also.

## 14. SERVICEBERRY.

(*Amelanchier*)

> " The shad-bush, white with flowers,
> Brightened the glens."—*Bryant.*

This is the name given to a few species of shrubs and small trees belonging mostly to North America, and variously known as Juneberry, ' sarvice ' berry, and shad-bush. It generally occurs in broken, hilly country and produces an abundance of edible, berry-like fruits. The species given below is common throughout the Rockies and is the only one that becomes a tree in this state, and that rarely, though it is abundant as a shrub.

### (1) WESTERN SERVICEBERRY.

(*Amelanchier alnifolia* Nutt.)

**Description.**—Leaves thick, rounded or elliptic, toothed around the upper half only: flowers in clusters (racemes), white, appearing before or with the leaves: fruit purple or nearly black when mature, ¼ to ⅓ inches in diameter.

Occurring among the hills throughout the state, especially along the streams at middle altitudes. The fruit is palatable, particularly if fresh, though it is used to a considerable extent as sauce and in pies. Ripening in July or August, according to altitude.

## Oleaster Family.

*(Elæagnaceæ).*

Two tree-like shrubs are to be mentioned under this family because of their ornamental value. Both have silvery foliage, due to minute scales which cover the surface. both have one-seeded fruits.

XXVI. SILVER BERRY. *Twigs, leaves and silvery fruit.*

## 15. SILVER BERRY.

(*Elæagnus argentea* Pursh.)

**Description.**—Leaves elliptic, silvery-scurfy as are also the twigs, flowers and fruit: fruit oval, ½ inch in diameter, dry, mealy: seed large, stone-like: branches without spines.

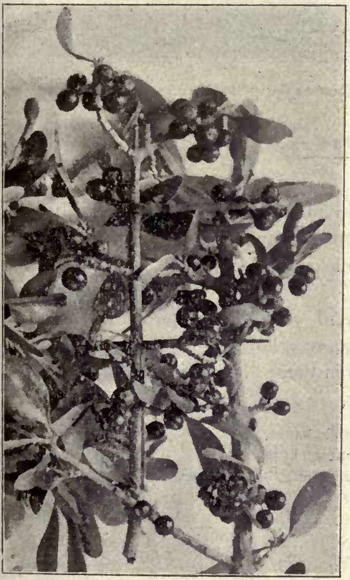
This beautiful shrub occurs in the northern and western parts of the state, mostly on the bluffs and ridges adjacent to streams. It is not common but may have a wider distribution than has yet been shown. Its perfectly matched leaves and fruit, as to color, makes it of much interest.

## 16. BUFFALO BERRY.

(*Lepargyrea argentea* (Nutt.) Greene)

**Description.**—Leaves oblong, obtuse, silvery on both sides: fruit a small, oval berry, bright scarlet when ripe, highly acid, edible: branches spiny.

This well known shrub occurs in many parts of the state, on the stream banks. Its silvery leaves and its profusion of small, scarlet berries give it a conspicuous beauty all its own. The fruits are largely gathered for the excellent jams and jellies that can be made from them. Screens and hedges of this useful shrub can be used to advantage by the landscape gardener on either home or public grounds.



XXVII.—Buffalo Berry. *Twigs in fruit.*

**XXVII. BUFFALO BERRY.** *A natural hedge of well grown shrubs.*

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Is it too much to hope that this bulletin may be one of the factors (however small) which shall arouse in our people a keener appreciation of the value of our forests, a more loyal support of all measures looking to their preservation, a greater interest in the beautifying of our homes and public grounds with trees and shrubbery and a more cheerful willingness to work and plant, that those who come after us may have a more wholesome and happier place in which to live ? As we interest ourselves in these directions, the love of nature will grow upon us and we too shall say,

> "And this our life, exempt from public haunt,
> Finds tongues in trees, books in running brooks,
> Sermons in stones, and good in every thing."—*Shakespeare.*

7

Walter Mulford

## UNIVERSITY OF WYOMING.

Agricultural College Department.

# WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

## BULLETIN NO. 57.

MARCH, 1903.

# Shade Tree Suggestions.

By AVEN NELSON.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.

# Wyoming Agricultural Experiment Station.

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PLATE I. A LARAMIE STREET.—*This shows what can be done at an altitude of more than 7000 feet.*

# Shade Tree Suggestions.

## INTRODUCTION.

If the presentation of a short bulletin on this subject needs justification, it may be found in the two following facts:

1. In this State thousands of dollars are expended every year for shade trees. A large part of this expenditure is either a total loss, or it gives very unsatisfactory results. It is hoped that this bulletin may contribute a little toward better results.

2. In this State thousands of dollars more than is now being spent could profitably be used, it is believed, in planting shade trees. Home grounds are still too often devoid of even the suggestion of verdure of any kind. Towns can be found in which a shade tree would be a curiosity. Only one real park exists in all the State. One or two others are being developed, but many more are wholly possible, at moderate expense. Villages and towns might add much to their beauty (see plate II); might materially enhance their property values by judicious planting upon the school grounds and along their usually broad streets and the highways leading to them. If this bulletin adds even a slight impetus to the movement for the adornment of home and municipal surrounding, its issuance will have been justified.

## CONDITIONS IN WYOMING.

This is a State characterized by its vast treeless plains, through which tree-bordered streams meander; by long lines of intersecting, undulating grassy hills, either naked or sparsely wooded; and by titanic mountain ranges, whose sides are darkened by dense forests, and whose alpine summits are effulgent with eternal snows. These physical characters show the course that nature has pursued in producing what we now call Wyoming. Results, as they are in a state of nature, do not show all that they may be under man's direction, but they do suggest some things that may not be. Many forms of plant life that we know once flourished here, unable to meet the changing climatic conditions of the passing geological ages, were gradually crowded out by the hardier and more plastic forms which were developing under the new environment. The vegetation of the State is what it is by reason of climatic and soil conditions. Under man's direction and care, it is altogether possible to materially increase this vegetation both in quantity and variety. The increase in variety, however, must come largely by introducing plants from localities where approximately similar environments appertain. If nature has left in Wyoming but three pines, two spruces, two firs, two junipers, one oak, five cottonwoods, and among the small or shrub-like trees, two birches, some willows, a few hawthorns, a buffalo berry and a few others, it would be idle to hope that a miscellaneous lot of lowland and Southern forms can even be made to live, much less to flourish, in even the most favorable localities. Our choice of trees for planting is, therefore, limited to a comparatively small number of species, enough, however, so that, by judicious selection and combination, a pleasing variety may be secured.

A word of caution to those who contemplate planting: Take into consideration the altitude, the average temperature, the extremes of temperature and the amount of water available. Make choice of trees for planting accordingly. Experiment, if you will, but, where results are wanted with certainty, follow lines that experience has showed to be safe. The nurserymen's catalogue is filled with many alluring pictures, and the agent describes them in the most glowing terms. Valuable novelties may, of course, be introduced from time to time, but do not venture much on untried things. Varieties, standard and all right in certain localities, may be altogether a failure in others. Not even the results in neighboring states are to be taken wholly as a guide. Personal attention, the exercise of good judgment in selecting and care in the the planting are the only sure methods to success.

## AVAILABLE TREES.

Bulletin No. 38, by Prof. B. C. Buffum, entitled, "Cultivated Shade and Forest Trees," discussed this question in some detail. In it the results of experiments with various kinds are set forth. Subsequent experiment and experience have further confirmed the observations contained in it. This bulletin is still available and may be had upon application to the Director, Experiment Station, Laramie, Wyo.

Briefly, it may be stated that cottonwoods thrive throughout the State; box-elder up to 7,000 feet; green ash and elm at lower altitudes; silver maple and possibly locust at the lowest altitudes. Some cultural varieties of poplar are also of use in many localities under 6,000 feet altitude. Quite a wealth of shrubs are available in nearly all localities and add much to the appearance of the home grounds. Willows, buffalo berry, alder, birch and others may often be used effectively.*

## WILD VERSUS NURSERY GROWN STOCK.

The choice must rest with each person concerned since various facts must be taken into consideration. In certain localities excellent wild trees are to be had for the trouble of digging them. This carries with it the additional advantage that they may be set out immediately without undue exposure of the root system to dry winds and scorching sun. Lack of shipping facilities, either because of distances and time that would endanger the trees, or prohibitory shipping charges, may make wild trees the only choice. They are not necessarily more hardy, as is sometimes supposed, nor do they as a rule grow as rapidly. They are often more stocky and, therefore, more suitable for windy situations than the tall, slender nursery grown stock, but as to root system they are frequently seriously deficient. Often one to three great roots only occur, and these run out long distances before they branch and give rise to the rootlets and root hairs. Therefore, in transplanting, the best part of the root system is lost, and the tree dies for want of water, since little water can be taken up by it till new rootlets and root hairs (water absorbing organs) have been produced upon the few large stumps of roots that were left upon it.

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*See Bulletin No. 54, The Shrubs of Wyoming, by Elias Nelson

On the other hand, nursery grown stock also has its advantages and disadvantages. In favor, it may be said, that varieties may often be secured that have shown advantages in vigor, in rapidity of growth, in freedom from disease, in beauty of form or foliage. If they have been properly grown in the nursery the root system is of the best. To secure this the nurseryman transplants yearly, or at least cuts the roots, at intervals of time, at a suitable distance from the trunk. This insures a close, compact root system, the whole of which may be transplanted, in consequence of which growth is soon re-established. The disadvantages have already been stated and need merely again be mentioned as original cost, heavy transportation charges, exposure in shipment, and especially often great seasonal differences between the location of the nursery and the place to which the trees are transplanted. If grown in a low altitude, they must be dug out and shipped before the season in high altitudes is open. This makes it necessary to "heel them in," causing some extra expense and additional dangers to the tree.

## TIME TO PLANT.

Everything considered, early spring seems to be the most favorable time. Fall planting is sometimes advocated, but in most parts of this State it cannot be done with safety, since irrigation is usually wholly suspended during the winter months, often for half a year. Should these months prove to be dry ones, the loss of many of the trees is inevitable. Though the life processes in our trees are dormant during this time, yet the loss of water by evaporation is not wholly checked. Newly transplanted trees are almost devoid of the root hairs through which absorption of water takes place. Absence of these, and possibly, also, of a source upon which to draw, makes it impossible that the tree should survive even a moderate loss. The tree may be unable to make good this loss, as already stated, for want of absorbing organs, or because the soil water is absent or frozen.

The actual time for planting must vary materially in different parts of the State, owing to the great differences in altitude. Any time from the first of April to the middle of May, that permits of the soil being properly worked, may be considered suitable as to time, providing the buds have not wholly opened. If the young leaves have appeared, the first windy, sunny day will most probably extract water from them to such an extent that they will shrivel and blacken as if by fire.

## CUTTING BACK.

When a tree is transplanted, the common practice of "cutting it back" is a good one, if by that phrase we mean a judicious reduction of leaf surface. Plants of all kinds carry an expanse of leaf surface proportioned to and conditioned upon the capacity for water absorption by the root system. Leaves are expensive, and their number and size are conditioned upon the income of the plant. Transplanting often reduces enormously, for a time, the income through the roots. Good judgment suggests that the expenses must be proportionately curtailed. This may be done by judicious trimming, keeping in mind two objects to be attained, viz., beauty of form and health of tissue.

## TOPPING.

This practice cannot be too strongly condemned, at least in so far as it pertains to the practice in this state. It has been the cause of a large portion of the loss, and one of the principal factors in the discouragement that tree planters feel. Wyoming's population is still largely adventive, rather than indigenous. The practices which our people employed elsewhere they naturally think ought to work here. Forgetting the dryness of the atmosphere, the shortness of the season and the slow growth under the reduced atmospheric pressure of this altitude, they slash the trees with the abandon that they practiced "in the East." With the impatience born of the zeal we show for quick results, we secure large trees for planting. Naturally they are deprived of most of their roots in the digging. To give them a slight show for their lives, the branches are lopped off and half (more or less) of the main axis is removed. Then these tall stumps are set out in the vain hope that they may develop rapidly into healthy, sightly trees. (See Fig. 1, plate III.) No matter what may have been our experience elsewhere, it is very certain that nothing but disappointment can come from such practice here. Not one in ten of *such* trees will prove permanently satisfactory. We shall not only suffer the loss of our money, but also, and that is worse, great loss of time in the attainment of the results we seek. The usual experience with such trees is about as follows: They are set out. Late in the spring they put out a cluster of new shoots near the top, but often a foot or more from the cut end. (See Fig. 2, plate III.) If the season be a favorable one, so that these twigs mature, they will survive the winter, and the next season this umbrella-like crown makes further growth, and the stumps are now crowned by a small spherical mass of crowded branches. In the center of this may be observed the cut end of the stem protruding as a dead snag. From this the bark soon peels off, water begins to enter the decaying end, the heart wood decomposes under the action of bacteria, which find entrance along with the water, and the tree soon has running sores lower down upon the stem, where branches have been severed. If the root-system has made

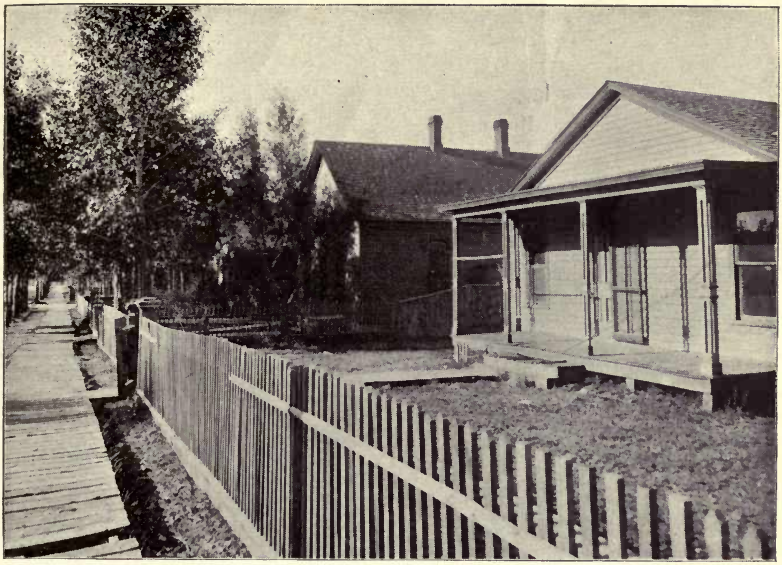

*Fig. 1. Other things being equal which one would you rent?*

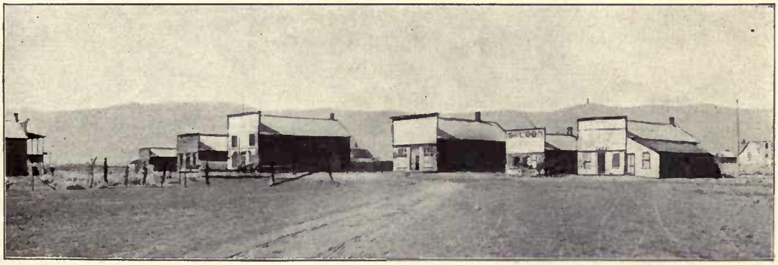

*Fig. 2. A treeless Wyoming village. No excuse for this,—low altitude, fertile soil, trees near by, irrigating ditch in every street, with an abundance of water.*

PLATE II. SOME WYOMING CONTRASTS.

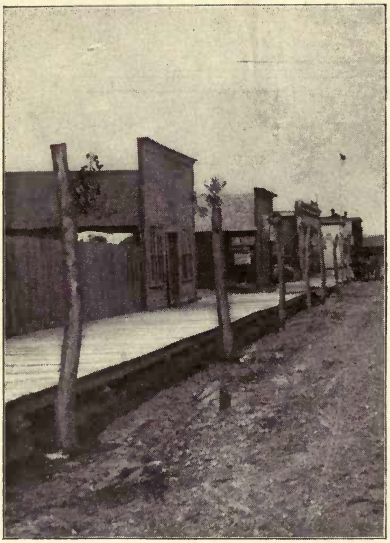

Fig. 1. *One way not to do it.*

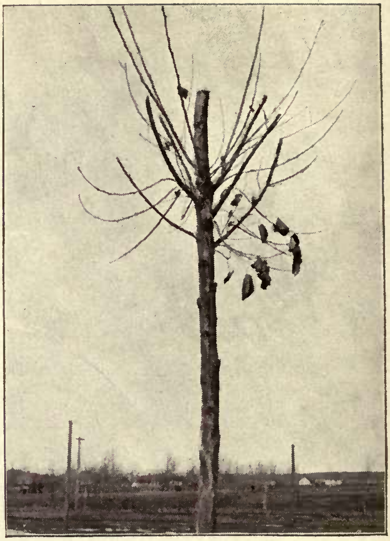

Fig. 2. *Doomed from the first.*

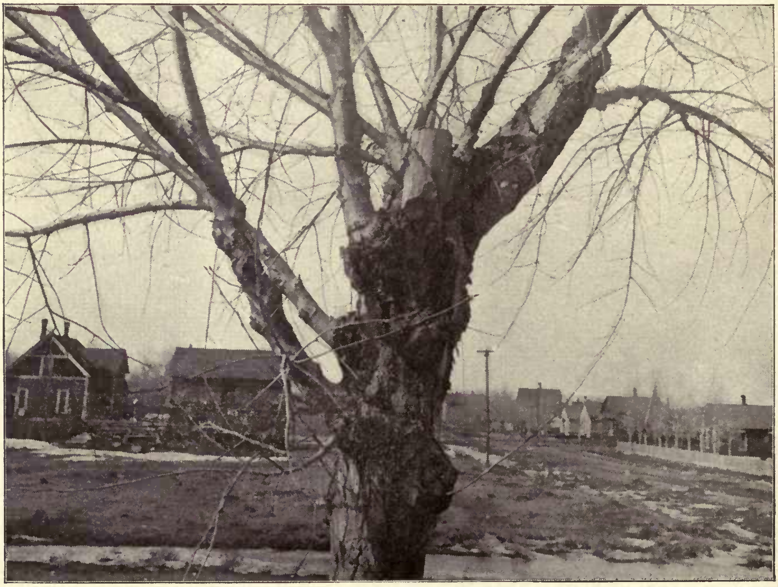

Fig. 3. *Struggling against fate—one of the most successful.*

PLATE III. "TOPPING" AND ITS RESULTS.

some development the tree may continue to live for a number of years, but it will always be a stump, crowned with stunted branches, whose support grows weaker year by year, as the sore grows larger and the heart wood less. Now any unusual stress of weather (wind, sleet or snow) gradually dismembers it. The tree, which has been a disappointment all these years, is now wholly gone. A decade has passed, and you are just where you began. Plate III, Fig. 3, shows the best that may be hoped for from such trees. Though this particular tree has survived for the unusually long time of twelve years (under the writer's observation), the sores at its crown are gradually getting the better of it, and in a year or two more the main branches will break off by reason of their own weight, and sooner if subjected to unusual stress. All experience, under the conditions found in Wyoming, indicate that the main axis (unless the trees be quite small) should be left untouched. (See Plate IV.)

## METHODS OF PLANTING.*

Cheap methods of planting produce cheaper results. Medium sized healthy trees will fully repay any extra expense incurred in giving them a fair chance. Crowding them into holes whose smallness is proportioned to the hardness and stoniness of the soil gives to the trees conditions which are unfavorable directly in the ratio of their needs. Starved plants are no more profitable than starved animals. Let the holes be made generously large. The stonier and harder the soil, the greater the need. Spread out the roots in a natural position. Cover with pulverized soil and shake down. Add alternate layers of well pulverized soil and well rotted manure or leaf compost. Saturate with water, so that the soil may settle around the roots, thus holding the tree firmly.

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*See Bulletin 38, already cited.

## PROTECTION OF YOUNG TREES.

For the first two or three years it is wisdom and economy to place some form of protection about the newly planted tree. This is especially true if it be planted on the street, where the town cow rubs it and horns it, and then walks astride of it to brush off the flies. By this treatment the roots are in one place today, another tomorrow, and if this alternating rotation be long continued, to have planted it were a waste of time and money. If by any chance the tree survives for a time, the abrasions of its bark give rise to sores, from which it never recovers. But whether planted on the street or under fence, a stay is of much value. While the soil is loose and the roots not established, high winds sway the tree back and forth, and make the establishment of a system of rootlets and root hairs an impossibility.

The form of the protector will depend upon the object in view. If it is merely a support, a straight pole of suitable height set firmly in the ground is sufficient. To this the tree is fastened by a band of rope, leather or cloth, padded with cotton or wool or other soft material. This may also be converted into a guard against animals by placing a small circle of wire netting around the tree, fastening the wire to the vertical pole.

The form of guard usually seen is the box-guard, made of narrow boards and enclosing the tree to a height of five feet or more. Mere protection against stock may also be secured by one or two strands of barb-wire stretched either side of the rows of trees. This may be accomplished with either one or two rows of posts. If but one row be used, the posts are set in line with the trees, and one or two transverse bars about five feet in length are nailed to the posts. Upon the ends of these the wires are stretched.

## PRUNING.

Three things may be attained by pruning, viz., symmetry of form, health of the tree, and rapidity of growth. The skillful pruner examines his tree before he begins, discovers the possibility that it presents and cuts accordingly. The health of the tree may be promoted by removal of dead and dying members and the destruction of germ and insect infected tissues. Wherever cuts occur the tree puts forth new tissues at a rate and in a manner which tends to cover up and heal over the newly made wound. If this be not accomplished in a reasonably short time the wound becomes filled with germs, causing disintegration of the tissues. To facilitate the healing of wounds, dead branches should be cut back to the healthy tissue and smoothed down. Stumps of branches with loosened bark are always points of infection. Large wounds can never safely be made, but where it is necessary to make them the cut should always be water-proofed by the application of thick coats of lead-paint or coal-tar. The best pruning is that which watches a tree, from the start, so closely that the removal of small twigs here, the pinching out of a bud there, and the foreshortening of some branches elsewhere is all that is necessary to the formation of a symmetrical tree. As time goes on it will, of course, be necessary to remove some of the branches, possibly some of the lower ones, usually some of the interior ones, in order to open up the crowded crown. Under the conditions that prevail in Wyoming, it should be said, NEVER CUT OUT THE MAIN AXIS, if it can possibly be avoided. An ignorant, indifferent and careless pruner can and will do far more harm than good. Broken and bruised branches, and large, open, unprotected wounds are all sources of infection and decay against which our trees, with their slow growth, struggle unsuccessfully.

All things considered, it seems that pruning may be done with the greatest safety in late winter or early spring. Large wounds especially should be made only while the tree is dormant, so that the surface of the cut tissues may dry and harden before the rise of the sap. If this drying of the wound does not take place, or if the cutting is done during the growing season, the tree "bleeds" injuriously. Besides, such bleeding wounds are always points of attack by insects and germs. Fall and winter pruning is all right except that it leaves the wounds for a longer time unprotected by new growth and increases the loss of water by evaporation during the winter months.

## INSECTS.

Shade trees are not exempt from insect pests and fungous diseases. Very few people are, however, willing to take the trouble to spray regularly, that these may be kept in check. Often it would be a matter of real economy to do so, but perhaps the best we can hope for, with the present interest in shade trees, is some care in the selection of species. Some are less subject to insects than others, and there is also a decided difference in the resistence to the attacks of fungi.

The cottonwoods are reasonably free from fungi, but the narrow leaved form is peculiarly susceptible to the attacks of the small green plant lice. The broad leaved and the lance leaved ("smooth-bark") species are fairly free from lice, but their leaves are in recent years greatly infested with the leaf-miner. Since all three of these are very important trees, in the higher altitudes of the state especially, we ought to take some precautions against these enemies.

Plant lice may be kept in check by spraying, and it is quite well established that their ravages may also be greatly checked by ridding the immediate vicinity of the trees of all ant nests. Ants feed upon the sweet exudation from the bodies of the lice, and because of this very personal interest in them the ants take great care not only in the preservation and distribution of the lice during the growing season, but great ingenuity is displayed in the wintering of their "cows," as the plant lice are often called. Destroy the ants. This may be done by scalding with hot water, or by the carbon bisulphide treatment.*

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*For methods see Bulletin 38, of this Station, in which will also be found directions for the destruction of other insect pests.

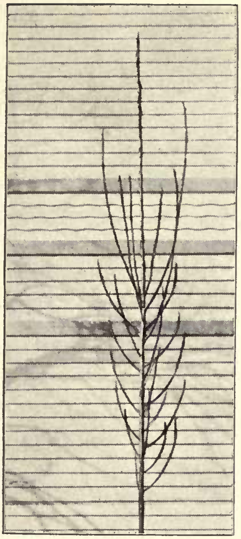

*Fig. 1. A well formed top.*

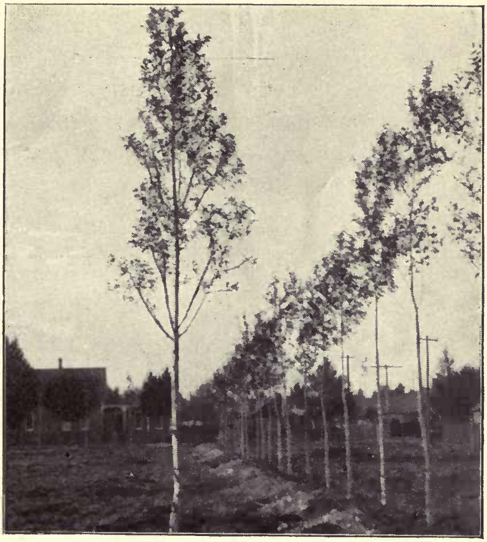

*Fig. 2. The first year of an excellent row (Laramie).*

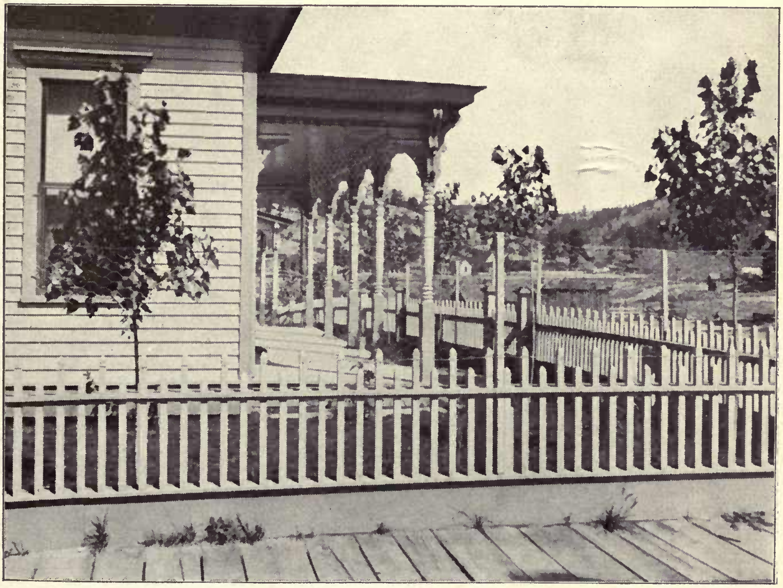

*Fig. 3. Well selected and of much promise (Newcastle).*

PLATE IV. SHAPELY AND ADAPTED TO WYOMING CONDITIONS.

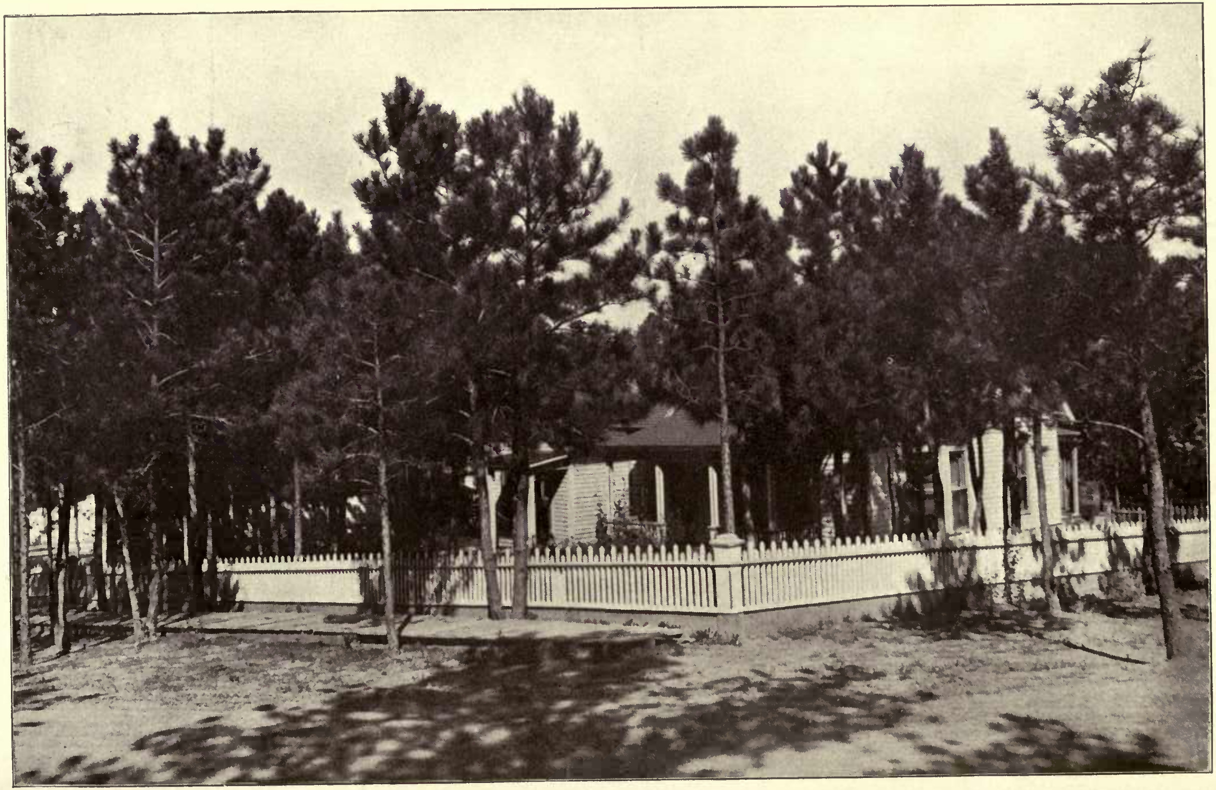

PLATE V. OCCUPYING A NATIVE GROVE. (NEWCASTLE).

The box-elder is a desirable tree at altitudes of less than 7,000 feet, but it is extremely subject to the attacks of leaf-eating insects.* The green ash and the elm are fairly free from insect attacks, but do not withstand the climate well in localities much above 6,000 feet.

## RUNNING SORES.

Injuries due to borers and the running sores produced by larvae of various insects, and especially by the plant lice, that at once established themselves in bruises and wounds, need immediate attention. The loss of sap stunts the tree, and, with the decline of its vigor, the disease spreads, the leaves turn yellow, mere existence results, and in a year or two the tree is dead.

Treatment of some kind is imperative. The following are methods often employed: Dig out all decayed tissue, being careful to remove all grubs and other larvae that may be found. If the wound is one that will conduct water to the interior of the stem it should be filled with grafting wax or putty, and then water-proofed with paint or tar. To destroy insects or their eggs and larvae in the smaller sores and in bark crevices, it is a common practice to whitewash the trunk and main branches, being careful to saturate all infested sores and crevices. While this is more or less effective, a more effective lime-wash is made as below, and may be freely used, especially if applied in the dormant state of the tree (Fall or Spring). It will be found very effective for the destruction of eggs, of larvae and of louse-like and scale insects.

*Lime, Sulphur and Salt Mixture.*—Lime 6 pounds, sulphur 4 pounds, salt 3 pounds, water 12 gallons; boil for one hour, and apply with a brush while fresh. (In making smaller or larger quantities, use ingredients in same proportions.)

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***For methods of treatment to destroy insect pests see Bulletin No. 7, Insecticides.**

## EVERGREEN TREES.

The native coniferous or evergreen trees (spruce, pine, etc.) are transplanted with great difficulty. Their root systems are such that, by the ordinary methods of transplanting, the more distant and, therefore, the more numerous roots and rootlets are severed from the tree. Besides, the finer rootlets are exceedingly sensitive and, on exposure to the dry air, lose water so rapidly that they are quickly wilted. From this they rarely recover. To transplant them successfully it is necessary to prevent this loss of moisture. This may be done, but only by the expenditure of much labor, in one of two ways, as follows:

Transplant in the winter from frozen soil. Cut out a sufficiently large block to include a reasonable portion of the root system. Transfer to new location with the soil intact. This may the more readily be done with trees found growing in moist situations in valleys, because of the character of the soil and the less wide-spread roots. Trees from dry hillsides are difficult to remove successfully, especially if the soil is stony, because of the few and greatly elongated roots. In moist soil trees and other plants do not have to reach out so far for water, and this no doubt accounts for the more compact root system.

2. Transplant in spring or summer. Retain intact the largest amount of soil that circumstances will permit. This will depend upon the character of the soil and the size of the tree (with its block of soil) that you are prepared to handle. If the tree is to be transported any considerable distance, it will be necessary to enclose the soil snugly in a burlap or gunnysack cover. Sew securely and handle carefully, so as to loosen the soil as little as possible. It usually will be found advisable to plant without removing the burlap. The roots will easily penetrate it.

Experience seems to show that all the evergreens may most safely be transplanted in late spring or early summer, just after growth has fairly started, that is when the buds are opening.

The actual date will, of course, vary according to the altitude.

Nursery grown stock transplants more safely than native trees, for reasons given in the paragraph on that subject.

## IRRIGATION.

Few, if any, of the trees ordinarily used can exist on the plains or table lands without irrigation. Since most of them occur naturally on stream banks, there is little probability that any of them will suffer because of excess of water. On the other hand, it should be said that it is not at all essential that they should be saturated all the time. A good soaking at intervals, the length of which will vary according to the character of the soil, will answer just as well. After the trees are well established the intervals may safely be lengthened.

Toward the end of the growing season, at least a few weeks before the early freezes, the water may well be turned off entirely. This permits the new wood to ripen up, and so it is less liable to be injured by the severe cold snaps that sometimes come in September. In late autumn and during the winter it is often well to irrigate at long intervals. In this one should be governed by the needs of the case. Some years of deficient rain and snowfall the soil may become almost wholly dry even in midwinter.* Then it is well to irrigate, for it is certainly true that even in their leafless condition trees lose some water. Evergreen trees, of course, much more, and these especially need some winter irrigation. One can find justification for such methods in nature. In examining the habitats of our native trees we find that most of them occur on wet, moisture-retaining soils, often where the soils are not only wet, but even flooded. The mountain groves have sprung up on the slopes and in the draws, where the winter snow drifts lie the deepest.

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*See Bulletin 15 of this Station, The Winter-killing of Trees and Shrubs.

## UTILIZING NATURAL GROVES.

This needs barely to be mentioned. Any one who cannot see the advisability of preserving and protecting trees already well established within the town or upon building lots will not be convinced by anything that might be said.

There is a charm about nature's planting that man rarely reproduces. His work is stiff and formal in its regularity. The lack of symmetry and the seeming disorder of nature appeals to us all. Let us then not consent for a moment, if we be so fortunate as to live where nature has planted, to the destruction of any worthy trees that it is possible to save. Who would not take delight in such a grove as is shown in Plate V? Let all such be utilized.

8

Walter Mulford

# UNIVERSITY OF WYOMING.

Agricultural College Department.

# WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

## BULLETIN NO. 54.

JULY, 1902.

# The Shrubs of Wyoming.

By ELIAS E. NELSON.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.

# Wyoming Agricultural Experiment Station.

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# The Shrubs of Wyoming.

BY ELIAS NELSON.

Our native shrubs are objects of more or less interest to all, and a bulletin treating of these, it has been thought, would be welcome to the people of the state. This bulletin has therefore been prepared as an aid in the identification of native shrubs, and it is hoped that it may be instrumental in creating a greater interest in these denizens of our hills, plains and mountains, and a more general planting of them for home decoration.

This station has already issued two bulletins on trees, one treating of the cultivated, the other of the native trees of this state.* It is now well to give shrubs some attention, and a bulletin dealing with our native ones is therefore published. It is hoped that this station may issue other bulletins, which shall treat more in detail of certain classes of shrubs of economic importance. It has seemed best to prepare as a first bulletin on the shrubs one including all those known to occur within our borders.

While the kinds of trees in the state are few, we have a great variety of shrubs. As objects of aesthetic value, they are of much interest. They beautify our water courses, forming delightful thickets and lining the streams with a pleasing variety of verdure. They occur as scattered growths on hillsides and in canons; fringe the borders of woods, and grow far up the sides of snow-capped mountain peaks. The copses and thickets of shrubs scattered in and about open woods give that charm and naturalness to the scene which man cannot reproduce. No landscape is complete without them.

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*In Bulletin No. 38, entitled "Cultivated Shade and Forest Trees," Prof B. C. Buffum treats of the trees which are generally planted or have been tried in Wyoming. Directions as to care and planting are included in this bulletin. Bulletin No. 40, by Prof. Aven Nelson, entitled "The Trees of Wyoming and How to Know Them," describes our native trees and contains numerous illustrations as an aid to their identification. The edition of this bulletin is now exhausted, and, hence, copies of it cannot now be furnished by the station.

## VALUE OF NATIVE GROWTHS.

Apart from aesthetic considerations, native growths of shrubbery are of much importance. The value of forests in retaining the water from melting snows in the mountains is well known, and in this shrubs aid very largely. Swales and mountain parks with their dense willow growths serve as storehouses of moisture, and thus supplement the influence which forests have in regulating the water supply. The preservation of the shrubs on the banks of our mountain brooklets is therefore of importance, as their destruction by fire or through excessive cropping by grazing animals will have the effect of increasing the flood waters of spring, resulting in a shortage of water later in the season. Small creeks often run dry earlier than otherwise in consequence of destruction of shrubs and other vegatation about their spring heads. The natural thickets in our valleys furnish shelter for stock during inclement weather, and the willows and other shrubs along the streams prevent the banks from washing. Ranch buildings, gardens and orchards can often be so located that they are sheltered by natural thickets. As windbreaks they are a source of some protection to fields of agricultural crops, and by deflecting the wind prevent the excessive evaporation, which accompanies dry winds passing unobstructed over the land.

## PLANTING OF NATIVE SHRUBS.

Our native shrubs may be planted for several purposes. Various ones may be used for ornamenting the home grounds. The buffalo-berry is an excellent shrub for hedges; willows may be planted for windbreaks or along canals and ditches to hold the banks in place, and several are of value for their fruits. Though most of them are not readily transplanted, they do well when once established. The smaller bushes should be selected, and the roots kept moist until planting, which should be as soon as possible. When practicable they may be dug up with the soils remaining about the roots, or wet burlap can be wrapped about the roots while bringing them home. It is best to heal them in temporarily, if they cannot be planted at once. The tops should be pruned to the same extent that the roots have been cut in digging. This is very important, as planting without any pruning accounts for most failures.

## NATIVE ORNAMENTAL SHRUBS.

Shrubs are of much value in ornamental gardening, and they add much to the attractiveness and beauty of the home grounds. They are as essential for good landscape effects on the lawn as are the shade trees. In any locality much use can be made of native species, and as a rule these may be secured with little expense. Most of the cultivated shrubs of the Eastern states will not thrive in Wyoming, at least not at the higher altitudes. We must, therefore, depend to a large extent upon the native varieties for home decoration. Many ornamental shrubs procurable from nurserymen do well in the lower altitudes of the eastern and northern parts of Wyoming. Certain native species may be used to advantage on the home grounds. Being natives and therefore suited to our climate, there is greater assurance of success in growing them than with the cultivated ones. They will give variety, and some are not without merit as ornamentals, indeed many are quite desirable for the lawn. To many persons it is a matter of much interest and considerable enjoyment to bring home and endeavor to grow the more deserving of the native sorts.

## NATIVE FRUITS.

Many of our native fruits are used to a considerable extent for culinary purposes. As they are often easily secured, they may be planted in gardens for home use. However, since there are cultivated varieties of various fruits which will succeed in this state it will not be advisable as a pecuniary consideration to make large plantations of any of these wild ones, except perhaps the wild plum or the flowering currant.

Some of our native fruits have no close kin in any of the cultivated fruits. The domestication and improvement of such would therefore be desirable. The buffalo-berry and the service-berry may be mentioned as kinds of fruit which are unknown in the market. Any improved variety of these evolved in the future will therefore be a welcome addition to our wealth of small fruits. The problem of improving certain native fruits will appeal to many persons. Such work is exceedingly engaging, and will afford a pleasurable pastime to those who have some leisure.

## PINE FAMILY.

### (Pinaceae).

The members of this family are nearly all cone-bearers, such as the pines, spruces and firs, and with a few exceptions are all evergreen. In some of these evergreens, as the common junipers, the cones are very small and modified so as not to be recognized as such, being generally known as berries. The larch, yew, arbor vitae and the giant redwood of California all belong to this family. The evergreens are among the most popular and most handsome of our ornamentals and are largely used for the decoration of home grounds and public parks. The pines and many other evergreen trees furnish us with vast quantities of valuable timber. From the balsam fir is obtained the fine turpentine known as Canada balsam, and the yellow pine of the southern United States yields tar, turpentine and rosin.

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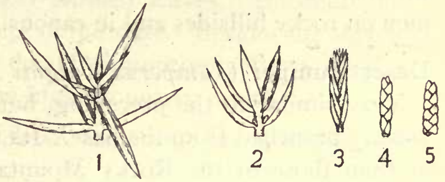
*Since the publication of Prof. Aven Nelson's bulletin on "The Trees of Wyoming and How to Know Them," another pine, the white-bark pine (*Pinus albicaulis*) has been found on the high Tetons.

In this state the family is represented by four pines,* two true spruces and the Douglas spruce, one fir and the following shrubs:

## JUNIPER.
### (Juniperus).



TWIGS OF THE JUNIPERS—1. Juniper. 2. Low Juniper. 3. Creeping Juniper. 4. Rocky Mountain Juniper. 5. Desert Juniper.

Five junipers are indigenous to Wyoming. The first three of these, which are also found in Europe and Asia, are low shrubs, while the last two often attain the size of trees.

**Juniper** (*Juniperus communis* L.)

A low spreading shrub with more or less drooping branches. The leaves are about three-quarters of an inch in length, and its dark blue berries are used for flavoring gin. It is found in the lower mountains and in the foothills more or less throughout the state.

**Low Juniper** (*Juniperus Sibirica* Burgsd.)

A low shrub of the higher mountains, very similar to the preceding, but with shorter leaves (half an inch long or less) and more depressed and somewhat matted.

**Creeping Juniper** (*Juniperus prostrata* Pers.)

A depressed evergreen shrub, with stems creeping over the surface of the ground. Its leaves are very short, sharp-pointed, somewhat scale-like and closely appressed to the twigs. This juniper is found at lower altitudes in central and northeastern Wyoming.

**Rocky Mountain Juniper** (*Juniperus scopulorum* Sarg.)

A stunted shrub or low massive tree, with a thick trunk and rounded top or sometimes branched from the base. Its leaves are mere scales which are opposite (in four ranks), thickened and closely appressed, thus forming a coating over the short slender twigs. The berries are usually very numerous and of a light green color when young, but of a bluish color at the end of the second season when mature. This juniper is common in the foothills more or less throughout the state, being very common on rocky hillsides and in canons.

**Desert Juniper** (*Juniperus Knighti* Aven Nelson).

Very similar to the preceding, but more bushy in form and usually branched from the base. Its twigs are somewhat thicker than those of the Rocky Mountain juniper, and its scale-like leaves are disposed in only three ranks. The berries are of a blue-green color and with slightly projecting points on the surface. It occurs in the desert region of southwestern Wyoming, where its scraggy clumps may be seen in places on the hills and bluffs otherwise devoid of trees or tree-like growths.

## WILLOW FAMILY.

### (Salicaceae).

The cottonwoods, the poplars and the aspen, as well as the willows, are all included in this family. The American aspen and four cottonwoods are native in the state, and a score or more of willows occur within our borders.

## WILLOW.

### (Salix).

Willows are very prevalent and abundant in the state. They are moisture-loving plants, familiar to everyone, occurring on all our streams and very common in the mountains. Their male and female flower clusters or catkins, which are usually erect, are borne on different bushes. The male plants of some of the species are quite handsome when covered with the yellow catkins in early spring. The minute greenish capsules of the female catkins soon burst open and discharge the silky seeds.

Though several willows of the state attain the size of trees, there is only one which is truly tree-like in its habit of growth. This is the almond-leaf willow (*Salix amygdaloides* Anders.), which may be known by its slender somewhat drooping branches and long-pointed and finely-toothed leaves. It occurs on river bottoms at lower altitudes in the state. Besides the shrubby species noted below, two dwarf diminutive willows, only a few inches high, are found on high mountain peaks.

**Western Black Willow** (*Salix lasiandra caudata* (Nutt.) Sudw.)

This is a very common willow on river banks in the state. It is shrubby in its habit of growth, and often attains a large size, having many trunks from the root. Its foliage is much like that of the almond-leaf willow, but the twigs are not so slender and the leaves on shorter and stouter stalks.

**Sandbar Willow** (*Salix fluviatilis* Nutt.)

This has a narrower leaf than any other willow in the state. It is a low shrub, 2-12 feet high, frequenting the moist sandy banks of streams. It has slender stems and branches, and a very erect habit of growth.

**Salix lutea** Nutt.

A very common willow several to ten feet high, widely distributed and occurring on most of the streams of the state. It has oblong leaves, less than two inches long. At the base of each leaf are two minute rounded leaves (stipules) which do not always persist.

**Nuttall's Willow** (*Salix Nuttallii* Sarg.)

A common willow on partially wooded slopes in the hills and lower mountains. It may be known by its broad, blunt leaves, which have entire margins, and are from 2 to 4 inches long. As it grows in moderately dry situations, it is the first willow in the spring to flower, the yellow catkins (the staminate ones) appearing very early and long before the leaves.

This willow is one of the best for home decoration, especially as it requires less water than other willows. If the male plants which bear the yellow catkins are planted, the bushes will be quite handsome and attractive when they flower early in the spring.

**Barclay's Willow** (*Salix Barclayi* Anders.)

This willow occurs in the mountains and is quite rare. It has large leaves much like those of Nuttall's willow, but the leaves are somewhat pointed and the margins toothed.

**Bebb's Willow** (*Salix Bebbiana* Sarg.)

This is one of the commonest willows in the state, being especially abundant on creeks in the foothills of the mountains. Unlike our other common willows it does not spread from the root, but has one or several large much-branching trunks and a rounded bushy top. Its leaves are of a dull-green color and only an inch and a half long. The small hairy capsules which contain the silky seeds are prominently beaked, and are borne on unusually long stalks.

On account of its striking habit of growth it may be used to advantage for ornamental purposes.

**Hoary Willow** (*Salix candida* Fluegge).

A low shrub, 2 to 5 feet high, with the young shoots and the under surfaces of the leaves densely white-woolly. The older branches are shining red and the leaves are from 2 to 4 inches long and less than an inch wide. This willow is very rare, being known only from the Centennial Valley.

**Green-leaved Willow** (*Salix chlorophylla* Anders.)

A low straggling willow, 1½ to 6 feet high, with dark-colored buds and twigs and glossy-green foliage. The leaves are whitish on their under surfaces and one to two inches long. It is a very common willow on the banks of rivulets and in bogs in our mountains.

**Bog Willow** (*Salix glaucops* Anders.)

A low but diffuse shrub with short, stout branches and oblong leaves, somewhat bluish beneath and about an inch and a half long. It occurs in low swales in the higher mountains.

**Hairy Willow** (*Salix stricta* (Anders.) Rydb.)

A low scraggy shrub, only one or two feet high, growing in bogs and on moist slopes in the mountains. The leaves are from ¾ to 1½ inches long and are covered with woolly hairs, but less densely so on their upper surfaces. In this and the two preceding willows the capsules which contain the seed are quite hairy.

**Wolf's Willow** (*Salix Wolfii* Bebb).

Much resembling the bog willow and hairy willow, but the capsules are smooth (without hairs) and its leaves are nearly devoid of woolly hairs. This is also a low mountain willow.

**Geyer's Willow** (*Salix Geyeriana* Anders.)

This willow is of frequent occurrence along streams in the foothills of the mountains. It grows 6 to 15 feet high, and is characterized by its bluish twigs. The leaves are rather narrow, either smooth or somewhat minutely hairy and from an inch to two inches long.

This is a handsome shrub which well deserves to be planted as an ornamental.

**Pelt-leaved Willow** (*Salix pellita* Anders.)

This has the bluish twigs of Geyer's willow, but the leaves are much larger (2-4 inches long) and have white shining under surfaces.

## BIRCH FAMILY.

### (Betulaceae).

This family is represented in Wyoming by three birches and one alder. "As in the willow family the flowers are borne in separate clusters, but in this on the same plant, while in the willows they are on separate plants. The male flowers are in slender, drooping clusters, while the female form shorter, thicker and erect aments. The numerous fruits in the clusters, when ripe, are small, flattened, one-seeded nutlets with a small thin wing at either side."

Our birches have slender, more or less spicy-aromatic, warty twigs. The paper birch, which becomes quite a tree, is found in the Black Hills of Wyoming. The following two are more generally distributed over the state:

**Glandular Birch** (*Betula glandulosa* Michx.)

A small shrub, 1 to 6 feet high, with brown or grayish, glandular-warty twigs and small roundish bluntly toothed leaves. It is common in the wet bogs of the higher mountains.

**Western Birch** (*Betula fontinalis* Sarg.)

A large shrub or tree, 10 to 20 feet high, growing in clumps and having smooth, dark-brown bark and grayish, resin-dotted twigs. Its leaves are sharply toothed, more or less pointed and from one to two inches in length.

The western birch occurs on the banks of many of the smaller streams of the state. It may be used to advantage for home decoration, the clumps with their dark trunks and branches and pretty foliage being very attractive on the borders of lawns.

**Paperleaf Alder** (*Alnus tenuifolia* Nutt.)

A shrub or small tree, often 20 feet high and with several trunks from the root. It has smooth, light-green, doubly-toothed leaves, considerably larger than those of the western birch. Its flowers are in clustered aments which develop during summer and remain naked on the twigs over winter, opening the next spring before the leaves appear.

The paperleaf alder is common throughout the state, occurring in large clumps on the banks of streams. This large shrub may be transplanted and used effectively to adorn the home grounds.

## GOOSEFOOT FAMILY.

### (Chenopodiaceae).

The members of the family are homely herbs and shrubby plants which are usually succulent, generally grayish in color and more or less scurfy, the flowers small, greenish and inconspicuous. To this family belong the cultivated beet, garden spinach, lamb's-quarters and Australian saltbush. It is represented in this state by various perennial herbs, many annuals, some of which are of a weedy character, and by a number of shrubs and undershrubs.

The saltbushes (*Atriplex* spp.) are grayish and more or less white-mealy or scurfy annuals or perennials, growing naturally on alkali lands in arid regions. In the Red Desert they are especially abundant and here furnish more than half of the winter forage for vast herds of sheep. All the saltbushes are readily eaten by stock, and several of our native ones are worthy of cultivation. There are seven native saltbushes in this state, three being annuals and four perennials. All the perennial ones are more or less woody at base, but only the two given below are distinctively shrubby. The first of these is commonly known as shad-scale.

**Shad-scale** (*Atriplex canescens* (Pursh) James).

A low grayish, scurfy shrub, two feet high or less, with narrowly oblong or linear leaves which are one-half to two inches long. This saltbush occurs on clayey hillsides and bluffs, being rather conspicuous toward the close of the growing season, when heavily loaded with the large succulent and 4-winged seeds (technically fruits). It is freely browsed by stock, and in Arizona and New Mexico is considered a valuable forage plant.

**Spiny Saltbush** (*Atriplex confertifolia* Wats.)

A much-branched, somewhat spiny, grayish shrub, one to several feet high. It is readily distinguished from the preceding by its broad leaves and very different seeds. The bracts which enclose the seed proper are thick and scurfy, and have broad, rounded, free terminal portions. It is very common in the Red Desert, and occurs on clayey alkaline flats elsewhere in the state.

**Winter Fat** (*Eurotia lanata* (Pursh) Moq.)

A perennial undershrub, one or two feet high, growing in dry gravelly soil on the plains and in the foothills. It has slender, woolly twigs and narrow, grayish, velvety leaves. Toward the end of the growing season the stems become loaded down with white, cottony seeds. This plant is highly prized by stockmen, especially for winter forage. Both the stems and cottony seeds are greedily eaten by stock, and wherever cattle have free range the plant is kept closely browsed down to the ground.

**Grayia** (*Grayia spinosa* (Hook.) Moq.)

A somewhat mealy undershrub, one to three feet high, with greenish leaves which are oblong or somewhat narrower. Its seeds (technically fruits) are flat and nearly round, white or pinkish in color and less than half an inch in diameter. Grayia occurs in alkaline soil in the central and southeastern part of Wyoming.

**Greasewood** (*Sarcobatus vermiculatus* (Hook.) Torr.)

An erect scraggy shrub, two to eight feet high, with white bark, rigid spreading branches and small worm-like leaves. The seeds are rendered quite conspicuous by the horizontal, membranous, veined wings. Greasewood is a characteristic shrub of alkali flats and clayey bluffs throughout the state.

## HYDRANGEA FAMILY.

### (Hydrangeaceae).

To this family belong the garden and greenhouse hydrangeas, the wild and cultivated syringas or mock oranges of the Eastern states and a number of native shrubs occurring in the

Winter Fat on the Plains.

western part of the United States. There are only two representatives of the family in this state.

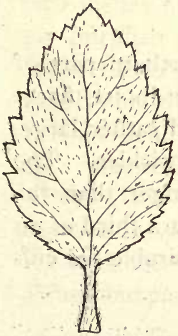
**Dwarf Syringa** (*Philadelphus occidentalis* Aven Nelson).

A low, much-branched shrub, with grayish, shreddy bark, the young twigs reddish in color and somewhat hairy. It has very small, sparsely hairy leaves and white flowers, one-half to three-fourths of an inch broad, borne singly or three together at the ends of the branches.

This small-leaved unattractive syringa is known only from the country directly south of Rock Springs, where it was discovered in 1897 by Prof. Aven Nelson, who gave it the name which it now bears. Its flowers alone are suggestive of its relationship to the large-leaved and handsomely flowered syringas with which gardeners in our Eastern States are familiar.

**Edwinia** (*Edwinia Americana* (T. & G.) Heller).

A diffusely branched shrub, two to four feet high, with shreddy bark and hairy branchlets. The leaves are evenly toothed, green above, soft hairy and grayish beneath, and an inch or more in length. It has showy, white flowers, three-fourths of an inch across and from five to ten in a cluster.



This shrub is found in southeastern Wyoming, especially in the broken country lying east of the Laramie Hills, where it grows among the boulders and clings in crevices on the rugged granite peaks. It is a handsome bush when profusely covered with the clusters of white flowers, and would be a very desirable shrub for the home grounds.

## GOOSEBERRY FAMILY.

### (Grossulariaceae).

This family embraces the grosselles, or the gooseberries and currants, familiar to everyone. These bush fruits are well represented in Wyoming, being common along our streams and in ravines of the foothills and mountains. The berries of all of them are edible, yet only some of the sorts are of sufficient value for culinary purposes to receive the attention of horticulturists. The one term *Ribes* includes both the currants and the gooseberries.

## GOOSEBERRY.

### (Ribes).

The gooseberries differ from the currants in having from one to three spines below the leaves or clusters of leaves. They often have scattered prickles on the stems as well, and the flowers are borne singly or two or three together.

The best and most successful varieties of gooseberries grown in the United States are of American origin, the English or European gooseberry (*Ribes Grossularia* L.) having been found too liable to the attacks of mildew in this country. The following gooseberries are natives of this state:

**Bristly Gooseberry** (*Ribes setosum* Lindl.)

This gooseberry occurs in the central and northern part of the state, growing on rocky exposed slopes or in moist places about thickets. Its spines are three together and rather large, and the stems usually densely studded with prickles. The flowers are whiter, somewhat narrower and longer than the western gooseberry. Its berries are red and about a third of an inch in diameter. Being very bristly it is not desirable for cultivation.

**Western Gooseberry** (*Ribes saxosum* Lindl.)

The most common and valuable of our native gooseberries. It may be distinguished from the preceding by its shorter and broader greenish flowers and its less spiny stems, the prickles being entirely absent or present only on the young branches. The berries are of good size, dark purple in color when ripe and covered with a bluish bloom.

The western gooseberry is very common along streams and creeks and in moist draws in the hills throughout the state. The berries are often gathered and used for pies and sauce. Douglas, an early explorer, says of this gooseberry: "Of all the species which came under my observation during my journeys in America, this is the finest in the flavor of its berries, as well as in their size." On rich river bottoms it is often very productive. In view of its fine berries and great vigor of the plant this gooseberry is well worthy of domestication. It is closely akin to the northern gooseberry (*Ribes oxyacanthoides* L.) of Canada and the Eastern States, which is the parent of our American gooseberries like the *Houghton* and *Downing*. Transplanted to the home garden into good soil it would undoubtedly produce a superior quality of fruit.

**Swamp Gooseberry** (*Ribes parvulum* (A. Gray) Rydb.)

A densely prickly shrub of wet woodlands and swamps. The leaves are smooth, deeply lobed and toothed, three-fourths to two inches broad. It has small saucer-shaped flowers which are purplish or greenish white and borne in drooping clusters. Its berries are dark purple or black when ripe and are beset with reddish bristles.

This shrub is common on the wet, shaded banks of our mountain streams. It does not appear to be of any horticultural value. This and the one following are peculiar in being intermediate between the gooseberries and currants, the berries being in clusters as in the garden currant, while the branches bear spines and prickles as in the gooseberries.

**Mountain Gooseberry** (*Ribes lentum* Jones).

A low shrub growing in open rocky slopes in the high mountains. Spines are present, but the older stems and often also the young branches are devoid of prickles. It has red berries of a very agreeable flavor. This gooseberry may prove to be of some value for its fruits.

## CURRANT.

### (Ribes).

The currants are devoid of spines and prickles and unlike the ordinary gooseberries their berries are several or many in a cluster. The red (*Ribes rubrum* L.) and black garden (*Ribes nigrum* L.) currants cultivated in the United States are of European origin. The American currants have not as yet given rise to any cultural varieties of great value. The first two native currants given below have the large leaves of the garden black currant and are very similar to it.

**Wild Black Currant** (*Ribes Americanum* Mill.)

A native black currant with large leaves, one to four inches broad and resinous-dotted beneath. It has white tubular flowers in drooping clusters, the parts of which are minutely hairy.

This currant is rare in the state, being known only from two localities in east central Wyoming. It is almost unknown in cultivation, but appears to be worthy the attention of fruit gardeners, as the good-sized musky-flavored berries borne in clusters may be capable of improvement.

**Northern Black Currant** (*Ribes Hudsonianum* Rich.)

This currant has the large leaves and black berries of the preceding, but the clusters of white flowers stand erect, and the individual flowers are shorter and more expanded. It has been found in the Yellowstone National Park.

**Pursh's Currant** (*Ribes viscosissimum* Pursh).

A bushy shrub, 2-6 feet high, with hairy and sticky foliage and young branches. Its leaves are roundish in outline, one to three inches broad and in appearance somewhat resembling those of the mallows. It has rather large viscid, greenish-white flowers (or sometimes purplish tinged), borne in short clusters. The berries are black, rough and hairy and of an unpleasant flavor.

This currant is found in the northwestern part of Wyoming, where it is not uncommon in dry open woods or on open slopes. The bushes are rather striking in appearance, and, as large fragrant flowers are produced in great abundance, it may be of some value as an ornamental.

**Squaw Currant** (*Ribes cereum* Dougl.)

An upright scraggy shrub, 1 to 3 feet high, with reddish brown stems and small (half an inch broad or rarely an inch), rounded, and usually resinous-dotted leaves. It has waxy-white or pinkish tubular flowers and medium sized red berries, which are sweet, but not agreeable to the taste.

Common in dry exposed situations in the foot hills and lower mountains throughout the state.

**Flowering Currant** (*Ribes longiflorum* Nutt.)

Also called *Buffalo* and *Missouri* Currant. A handsome shrub with glossy, 3- to 5-lobed leaves and yellow tubular flowers produced in great abundance.

The flowering currant is cultivated both in this country and in Europe as a flowering shrub. It is graceful, blossoms profusely, and is very desirable as an ornamental for the home grounds. It is more or less common throughout the state, except at higher altitudes, and adapts itself readily to cultivation. It may be seen on many lawns in the state.

As a bush fruit it is of much importance. The berries are in small and short leafy-bracted clusters, and unlike the red and black garden currants have to be picked singly as do the gooseberries. The fruits are either black, golden-yellow or cherry-red and are often of good size and each has a distinct flavor. The black have a somewhat tough skin and a peculiar flavor which is not agreeable to most people. Some persons, however, do not find them unpleasant to the taste. The berries are much gathered along with the yellow and used especially for making jelly. The cultural variety known as the *Crandall* has been derived from the black form of the flowering currant.

The yellow form is less common in the state than the black. In the valley of the North Platte it is quite abundant and here its berries are of good size. The residents in the districts where it grows are unanimous in pronouncing it far superior in flavor and value for culinary purposes to the ordinary black form generally growing along with it. It is strange that it should have so long escaped the attention of small-fruit growers.

One need not dwell upon the merits of this currant, as these are quite well known to residents in many parts of the state. Under cultivation it will without doubt be more productive, and farmers and fruit growers may well transplant it to their gardens.

## ROSE FAMILY.
### (Rosaceae).

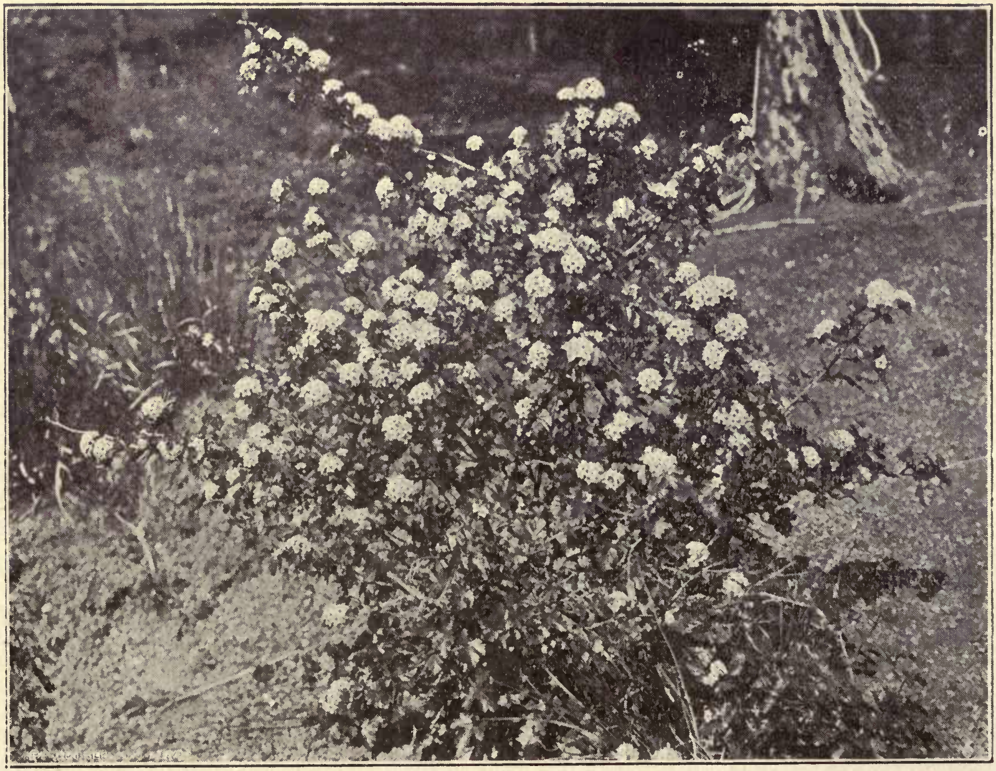
To this family belong many useful plants, such as the roses, raspberries, dewberries and strawberries. In this state the family is represented by a few native small fruits and by quite a number of shrubs.

The common ninebark of the Eastern States is not found in Wyoming. We have, however, two species in this state which are akin to it.

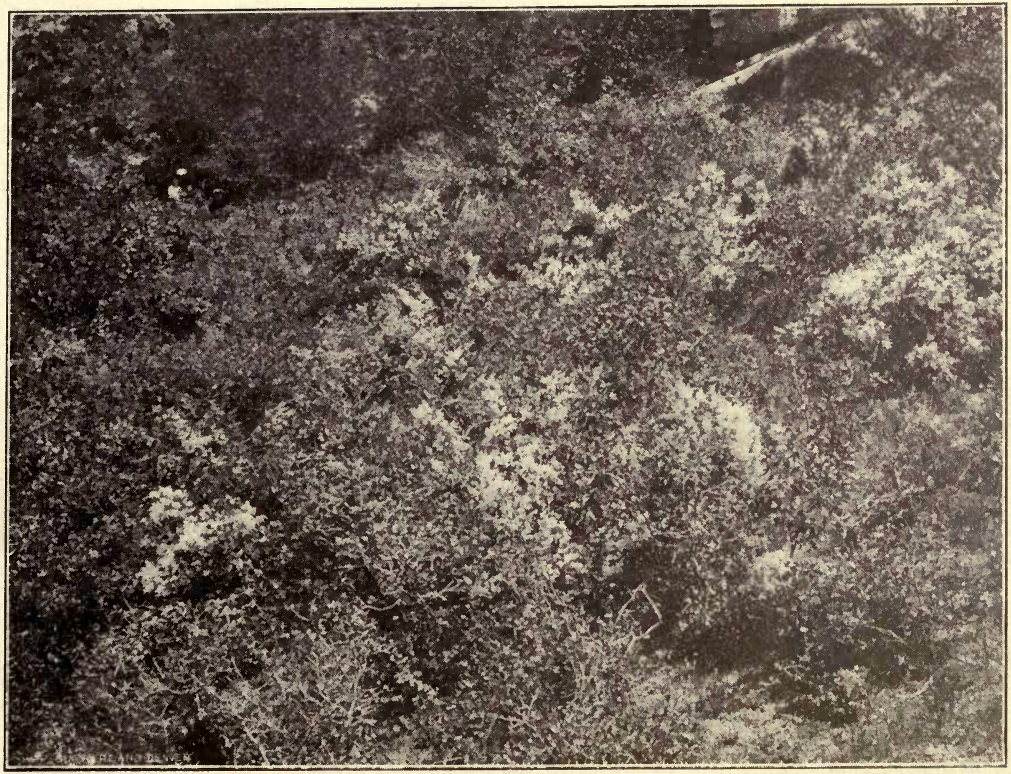
**Ninebark** (*Opulaster monogynus* (Torr.) Kuntze).

A small bushy shrub, 2 or 3 feet high, with small, bright-green, toothed and three-lobed leaves and numerous clusters (about an inch broad) of white flowers. The older branches and the stems have grayish bark which comes off in shreds.

The ninebark, though having smaller leaves and flowers than the eastern one, which is often cultivated, is not without merit as a shrub for the home grounds. It is not especially abundant in Wyoming, but occurs more or less throughout the state, on rocky hillsides or occasionally on the banks of rivulets.



NINEBARK (OPULASTER MONOGYNUS). (Reproduced from photograph by F. E. Clements.)



HOLODISCUS DUMOSUS. (Reproduced from photograph by F. E. Clements.)

**Ninebark** (*Opulaster pauciflorus* (T. & G.) Heller).

With larger leaves and more showy flowers than the preceding. It is a handsome shrub, often 4 to 5 feet tall, very desirable for cultivation. It is known to occur in the Yellowstone National Park and will perhaps be found in other parts of northern Wyoming.

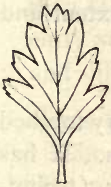
**Nuttall's Spiraea** (*Spiraea densifolia* Nutt.)

Tufted and with erect branched stems, one to two feet high, arising from underground rootstalks. It has oblong leaves, one to one and a half inches long and the slender erect branches are terminated by small but dense clusters of purple or rose-colored flowers. A very handsome shrub of a low and somewhat bedded habit of growth, occurring in the mountains of northwestern Wyoming.

There is another closely related species (*Spiraea lucida* Dougl.), having unbranched stems and larger clusters of white flowers, which is found in the Teton mountains and in the northern part of the state.

**Holodiscus dumosus** (Nutt.) Heller.

A diffuse shrub, often 4 feet high or more, with very large clusters of small white flowers terminating the branches. It has small broad leaves which are silky beneath but green above, deeply toothed above the broadly wedge-shaped base.



There is apparently no common name for this handsome and profusely flowered shrub. It is found on rocky slopes and ledges at lower altitudes in the state. In Central Wyoming it is especially common. It is an exceedingly pretty bush when in flower, and is one of the best of our native shrubs for ornamental planting.

**Rocky Mountain Thimble-berry** (*Rubus parviflorus* Nutt.)

An attractive shrub with erect or drooping stems or canes, three to eight feet high, and very large five-lobed leaves. It has large white flowers, an inch or two broad, and red pleasantly flavored fruits.

This thimble-berry occurs about thickets along streams in the hills and lower mountains. It is of no value for its berries, but on account of its ample foliage and showy flowers it is a desirable ornamental. Very little has been done to cultivate this shrub in the United States, but it has been introduced into Europe and is there known to gardeners.

**American Red Raspberry** (*Rubus strigosus* Michx.)

The wild raspberry of Wyoming, which is familiar to everyone, is also found throughout the greater part of the United States. It was early domesticated in the Eastern States, and is the parent of some of the cultivated red raspberries. It is quite common in many localities in this state and its berries are assiduously gathered for home use.

**Shrubby Cinquefoil** (*Dasiphora fruticosa* (L.) Rydb.)

A much-branched shrub, one to five feet high, with grayish silky leaves. Its yellow flowers, somewhat resembling those of a buttercup, are produced continuously throughout the summer. It is common in swamps and moist places. This shrub is cultivated to some extent and may be used to advantage on the lawn.

**Cercocarpus parvifolius** Nutt.

A scraggy shrub, three to six feet or more high, hairy toothed leaves more or less silky above but whitish beneath. It has small whitish flowers borne on stout stalks (technically the calyx tube and short pedicel) among the leaves. The seeds have feathery tails, two to four inches long.

This is a characteristic shrub on rocky slopes and ledges in the foothills and lower mountains throughout the state. This species and the following are often called mountain mahogany, but this name is somewhat misleading as the true mahogany (*Swietenia mahogani* L.) is a tree very different from these shrubs.

**Cercocarpus ledifolius** Nutt.

This has seeds like those of the preceding, but the young shoots are somewhat woolly and the leaves narrower and not toothed. In Wyoming this is a more diffuse shrub than the preceding. It is known to occur in the Big Horn mountains.

**Kunzia tridentata** (Pursh) Spreng.

A low, depressed and diffusely branched shrub with grayish branches and very small (less than half an inch long) leaves. The latter are three-toothed and wedge-shaped, green above, white beneath. In spring the bushes become covered with yellow flowers (one-third of an inch broad), which later are replaced by beaked, and somewhat egg-shaped minutely hairy fruits (these not fleshy or berry-like). Common in the hills, usually in draws and ravines or occasionally on sandy plains.

## ROSE.

### (Rosa).

Native roses are common in the state. Their pink, fragrant flowers and attractive foliage make them general favorites, and they are therefore perhaps more often planted about the home than other native shrubs. On account of their habit of persistently suckering from the root they at times become a nuisance and difficult to eradicate.

**Say's Rose** (*Rosa Sayi* Schwein.)

The largest flowered as well as the largest leaved of our native roses. It is characterized by the slender prickles of its stems and branches. Its leaves are composed of about seven leaflets which are an inch or more in length. It grows one to two or three feet high and is most frequently found about thickets and on partially wooded slopes.

**Prairie Rose** (*Rosa pratincola* Greene).

A low (one to two feet high), simple-stemmed rose, bearing its flowers terminally and having weak purple prickles. The leaflets are nine or eleven (occasionally seven) in number and about an inch long. This rose occurs in the prairie region of the eastern part of the state, where it often becomes a troublesome weed in cultivated fields.

**Wyoming Rose** (*Rosa grosseserrata* Elias Nelson).

A bushy, much-branched rose, several feet high, usually occurring on river banks. Its leaves are composed of five or seven leaflets, about an inch or an inch and a half long. The prickles are very few but stronger than in the two preceding.

**Woods' Rose** (*Rosa Woodsii* Lindl.)

The common rose of the rocky slopes and ravines in the hills. It is from a few inches to two or three feet high and has green, shining foliage and much smaller flowers than the prickly rose. The leaflets are from five to seven and about three-quarters of an inch long. The stems are usually beset with stoutish prickles, but may sometimes be found entirely unarmed.

**Fendler's Rose** (*Rosa Fendleri* Crepin).

The common rose growing along streams. It may be known by the dull-greenish color of its foliage and the very small leaflets, which are only about half an inch long and usually seven in number. It is several feet high and of a bushy habit of growth. This rose and the preceding are the ones generally seen in town lots.

## APPLE FAMILY.

### (Pomaceae).

This family embraces various trees and shrubs having apple-like fruits or pomes. To it belong such valuable fruits as the apple, pear, and quince. Our hawthorns and the service-berry are also members of the apple family.

**American Mountain Ash** (*Sorbus sambucifolia* (C. & S.) Roem.)

An erect, elder-leaved shrub, three to eight feet high, with large showy clusters of red berries in autumn. The leaflets are narrowly oblong, sharply toothed and in four to six pairs.

This mountain ash is rare in the mountains of this state. It is closely related to the European and the American mountain ash, both of which are often planted for ornament in the Eastern States.

**Western Service-berry or June-berry** (*Amelanchier alnifolia* Nutt.)

A common shrub among the hills throughout the state. It may be known by its rounded leaves, toothed above the middle, the clusters of white flowers and the purplish, berry-like, edible fruits, which are one-fourth to one-third of an inch in diameter.

The western service-berry is a very handsome flowering shrub and may well be planted on lawns. Its fruits are sweet and of a pleasant flavor, good to eat from the hand. It is often gathered and used especially for pies. This service-berry is cultivated to some extent both as an ornamental and for its fruits. It has given rise to the cultural varieties, "Alpina," "Gardener," "Williams," and "Greene." It is easily grown, propagating itself readily from seed and is often multiplied from the sprouts which arise about the base of the plants.

## HAW or HAWTHORN.
## (Crataegus).

The haws are shrubs or small trees, bearing large thorns on the branches and with showy white flowers produced in great abundance. They have small berries borne in clusters and containing large bony seeds. There are two species in this state, both of which are desirable ornamentals and well worthy of cultivation. Their berries though edible are apparently of no value.

**Black Haw** (*Crataegus rivularis* Nutt.)

This grows as a large shrub or a small tree with rounded bushy top. Its small leaves are oblong, pointed at both ends and sharply toothed. The berries are about three-eighths of an inch in diameter, red in color changing to purple-black when ripe. This species is common about thickets and along streams throughout the state.

**Long-spine Haw** (*Crataegus macracantha* (Lindl.) Lodd.)

More shrub-like than the preceding and with broader leaves and fruits which are red when ripe. The leafstalks and young branches are somewhat hairy, as also the under surfaces of the leaves. This haw is known to occur in the northeastern part of the state.

## PLUM FAMILY.

### (Drupaceae).

This family embraces various trees and shrubs bearing stone-fruits (drupes), the stone-like seed or pits singly in each fruit. To it belong the plums, cherries, the almond, apricot and the peach. In this state it is represented by the wild plum and by three native cherries.

**Wild Plum** (*Prunus Americana* Marsh).

The common wild plum occurs along streams at lower altitudes in the eastern part of the state. It may be distinguished in its winter condition from the native choke-cherry by its tree-like habit of growth and by its branches, which are more or less thorny. Its leaves also have larger teeth and are more pointed than those of the choke-cherry.

The wild plum has given rise to forty or more named varieties cultivated for their fruits. Even in its wild state the fruits are of good quality and very desirable for preserves and jams. This native fruit is easily brought under cultivation, and when grown in the garden produces a better quality of fruit than in the wild state. Its masses of white flowers in spring and its graceful head make it a desirable ornamental. It forms a very good hedge, and as such will serve the purpose of a windbreak, and would have the additional value of being fruit bearing.

**Rocky Mountain Cherry** (*Prunus demissa melanocarpa* Aven Nelson).*

This is the well known wild cherry, which is common throughout the state. It is usually only a shrub, often forming small groves along streams, but occasionally attaining tree-like size in favored situations. On account of its showy, white flowers it is of some value as an ornamental, while its sweet, but slightly astringent, black fruits make an excellent jelly. The flowers and the fruits are borne in elongated (racemed) clusters unlike those of the garden cherries. At lower altitudes in the state it is very productive, but in the lower mountains, where it also occurs, it is late in maturing and seldom bears fruit in abundance.

**Wild Red Cherry, Pin or Pigeon Cherry** (*Prunus Pennsylvanica* L. f.)

This cherry is rare in this state, having been found only in Crook and Sheridan counties. In the Mississippi Valley States and in the Eastern States it grows to be a tree 20 to 30 feet high, but with us it is only a shrub. It differs from the common wild cherry of the state in that its flowers and fruits are not borne in long clusters, but are crowded close together usually at the end of the very short twigs. It has also smaller red fruits which are not edible. This cherry is occasionally used for ornamental purposes in the eastern United States.

**Western Sand Cherry** (*Prunus Besseyi* Bailey).

A dwarf cherry, a few inches to four feet high, the branches diffuse and spreading. It has small, oblong leaves, which are green and shining above, whitish beneath. The fruits are black when ripe, one-half to three-fourths of an inch in diameter,

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*Since the publication of Bulletin No. 40, entitled "The Trees of Wyoming and How to Know Them," Prof. Aven Nelson has found that our native cherry is different from the *Prunus demissa* occurring in Washington and Oregon, and has given it the varietal name of *melanocarpa* meaning black-fruited.

and are borne singly or a few together on short stalks.

This little cherry is rare in this state, being known only from one locality, Glenrock, in Converse county, where it was discovered last year by Prof. Aven Nelson growing on the sandstone cliffs near the city. It is common in Nebraska, Kansas and the Dakotas, where it is being brought under cultivation both for its fruits and as an ornamental flowering shrub. Its fruits are of fair size and of good quality though often bitterish. It has of late years attracted much attention as a cherry for this western region. It is easily propagated and fruits the second and third years from seed. Many culturists are now bent on improving this promising cherry. It has given rise to the "Improved Dwarf Rocky Mountain Cherry" which has been in cultivation for a number of years.

## PEA FAMILY.

### (Papilionaceae).

A large family, including many useful plants. To it belong the garden pea and bean, the leguminous forage plants (alfalfa, clover, vetches, etc.) and the locust tree. In this state it is represented by one hundred or more perennial herbs, but by only one shrub.

**False Indigo** (*Amorpha fruticosa* L.)

A medium-sized shrub with long spikes of violet-purple flowers, small two-seeded and elongated leaves composed of 5 to 10 pairs of leaflets. It is found along streams in the eastern part of the state. It is a graceful flowering shrub very desirable for ornamental planting.

## SUMAC FAMILY.

### (Anacardiaceae).

This family is represented by three* species in this state, only two of which are shrubs.

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*The third species is the dwarf poison ivy (*Rhus Rydbergii* Small) which is poisonous to some people, causing inflamed eruption of the skin.

**Smooth Sumac** (*Rhus glabra* L.)

A much-branched shrub, 3 to 12 feet high, with large and dense clusters of yellowish-green flowers and ample foliage. Its leaves are composed of from 8 to 15 pairs of leaflets, which are lance-shaped and coarsely toothed, green above and white beneath. Its fruit is rather attractive, the small berries being hairy and scarlet in color, sour but agreeable to the taste.

This shrub grows on rocky uplands. It is known to occur in a few localities in the northeastern part of the state. The bark and leaves are used for tanning leather, while the fruit is of some medicinal value.

**Skunk-bush** (*Rhus trilobata* Nutt.)

A low straggling shrub, two to five feet high, having small three-lobed leaves and round clusters of yellowish-green flowers and somewhat sticky red berries.

This ill-scented shrub is found throughout the state in the foothills and on sandy slopes in valleys.

## STAFF-TREE FAMILY.

### (Celastraceae).

To this family belong the staff-tree, the burning bush, the spindle tree and the climbing bittersweet. None of these shrubs are found in this state but the family is represented by the following species:

**Western Mountain Lover** (*Pachystima Myrsinites* Raf.)

A low evergreen shrub, growing in rocky places on partially wooded slopes in the mountains. Its branches are densely leafy, the leaves being small and firm, oblong and finely and sharply toothed. The purplish flowers are minute and inconspicuous.

This little shrub has been found in several localities in the western part of the state, and also in the Sierra Madre mountains of Carbon county. This evergreen is quite pretty and very desirable as a small ornamental for the lawn.

## MAPLE FAMILY.

### (Aceraceae).

Only two maples are found in this state. One of these, the large-toothed maple, occurring near Evanston, in the southwestern part of the state, grows as a tree and on account of its thick and firm leaves is usually mistaken for an oak. The other, the dwarf maple, grows in clumps and is hardly more than a shrub. The box elder also belongs to this family.

**Dwarf Maple** (*Acer glabrum* Torr.)

This rarely grows to the size of a tree. It has the foliage, flowers, and the winged twin fruits characteristic of maples. The foliage though not dense is graceful, making the clumps rather attractive. The shrub is common in canons and on rocky slopes more or less throughout the state.

## BUCKTHORN FAMILY.

### (Rhamnaceae).

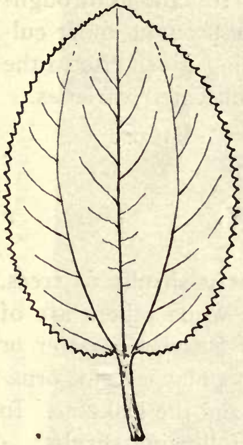
This family has three representatives in this state. To it belong the buckthorns, New Jerscey tea and Supple-Jack, all of which are natives of the Eastern States.

**Alder-leaved Buckthorn** (*Rhamnus alnifolia* L'Her.)

A small shrub, 2 to 4 feet high, growing in swamps. The leaves are rather ample, very green and resembling those of an alder. Its flowers are greenish and inconspicuous.

On account of its dark green foliage this shrub is striking in appearance. It occurs in the northwestern part of the state.

**Velvety Red-root** (*Ceanothus velutinus* Dougl.)



A diffuse and widely spreading evergreen shrub, with shining foliage and showy white flowers. Its leaves are about two inches long, oval in outline and with very minute black-tipped teeth, resinous and shining on their upper surfaces, whitish and more or less velvety beneath. In spring the bushes are profusely covered with large clusters of white flowers, which later are replaced by small, hard, greenish-black, resinous three-lobed fruits.

This red-root is common throughout the state, growing on rocky slopes in the hills and mountains. If often grows in immense patches and when in flower is very handsome. As the single large root is very deep-seated, it would be difficult to transplant.

**Fendler's Red-root** (*Ceanothus Fendleri* A. Gray).

A low and much-branched spreading shrub with bluish-gray, spiny branches and small narrowly oblong leaves about three-fourths of an inch in length. It has small clusters of white flowers and fruits like the preceding species. An infrequent shrub, growing on canon sides and wooded slopes in the eastern part of the state.

## GRAPE FAMILY.

### (Vitaceae).

Only one group occurs in this state, but another member of this family, the Virgina Creeper,* is common in some localities.

**Riverbank Grape** (*Vitis vulpina* L.)

This native grape is found on river banks in canons at lower

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*The Virginia creeper is 5-leaved (technically having five leaflets) and should not be conused with the dwarf poison ivy (*Rhus Rydbergii* Small) which often grows along with it.

altitudes in the eastern part of the state. The fruit is often gathered for home use, especially for jelly. It is found throughout the eastern United States and was early brought under cultivation. It has either directly or by crossing given rise to the "Clinton," "Elvira," "Pearl" and other cultivated varieties.

## OLEASTER FAMILY.

### (Elaeagnaceae).

This family embraces some silvery-scurfy shrubs or trees, some of which are desirable ornamentals while others are of value for their fruits. To it belongs the Russian oleaster or Russian olive, which is becoming quite a popular tree for ornament and for hedges in Kansas, Nebraska and the Dakotas. In this state the family is represented by the following shrubs:

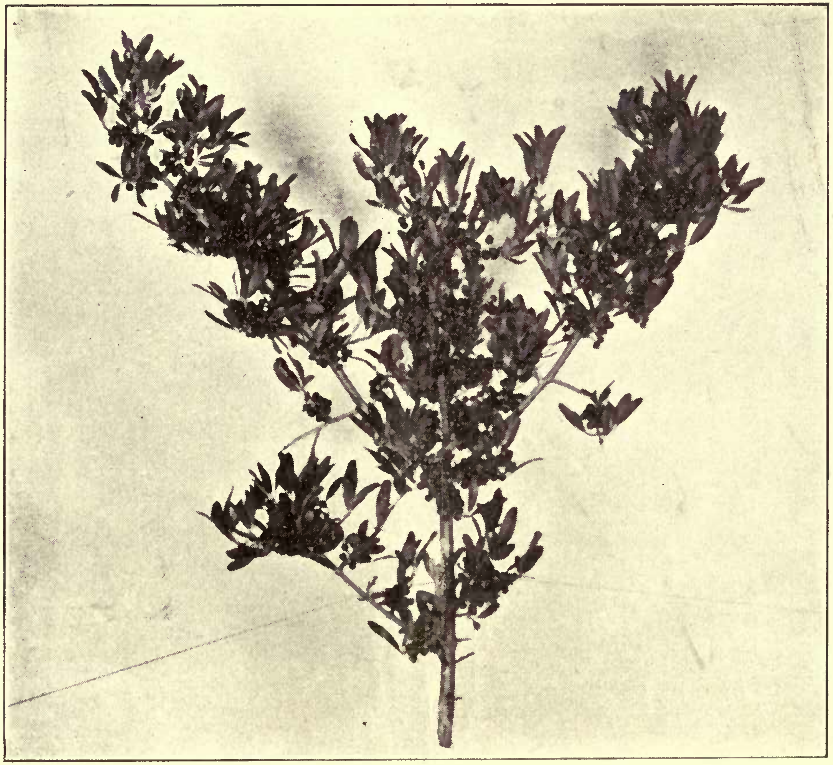
**Buffalo-berry** (*Lepargyraea argentea* (Nutt.) Greene).

A middle-sized or large shrub with thorny twigs and grayish and more or less silvery-scurfy foliage. It has very sour, edible berries, either scarlet or yellow in color. It is common on banks of streams at lower altitudes.

The buffalo-berry is cultivated to some extent both for its fruits and as an ornamental. On account of its dense habit of growth it is one of the best shrubs for hedges. Its berries are of much value, making a jelly of fine quality. Owing to the thorny twigs the berries can not be readily picked by hand. Hence it is a common practice among the berry gatherers to break off the branches of the wild bushes and beat off the berries on a sheet or tarpaulin spread on the ground. Such treatment is destructive of the bushes, and unless an unarmed or thornless variety can be evolved this shrub will never be grown to any great extent for its fruits. It is hardy and very productive and as a small fruit it is well worthy of improvement.

All the bushes do not bear fruit. The sterile plants, or male plants, "may be known in their winter condition by the dense

RIVERBANK GRAPE. (Reproduced from photograph by Aven Nelson.)



Buffalo Berry.

clusters of rounded flower buds"; the fruit-bearing or female plants "by the smaller, flattened, fewer, more slender flower buds." If planted for its fruit, both sterile and fruit-bearing plants should be set out, otherwise no fruit will be produced. It may be grown from seed or multiplied by means of cutting and by sprouts from the roots.

**Canadian Buffalo-berry** (*Lepargyraea Canadensis* (L.) Greene).

A low, depressed shrub, one to several feet high, with brown-dotted and scurfy young twigs, and oval leaves which are green above, silvery-scurfy and brown-dotted beneath. It has a red berry which is bitter to the taste and of no value for culinary purposes.

This low spreading shrub is common on wooded hillsides and on the borders of bogs. It is low and of a spreading habit of growth, bearing very little resemblance to the buffalo-berry.

**Silver Berry** (*Eleagnus argentea* Pursh).

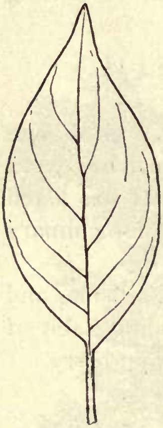
An unarmed shrub, 4 to 12 feet high, with shining, silvery-scurfy foliage and brown-dotted young twigs. The leaves are oval or oblong, larger and broader than those of the buffalo-berry. It has dry, mealy, one-seeded berries, silvery-gray on the surface.

The silver berry is found in the northern and western parts of the state, occurring on bluffs and bench-land adjacent to streams. On account of the grayish color of the plant and its shining foliage, the shrub is striking in appearance and very desirable as an ornamental.

## DOGWOOD FAMILY.

### (Cornaceae).

In this family are included the sour gum tree, the common cornels or dogwoods and many other shrubs and trees. Several of the American dogwoods and also some European and a Siberian species are planted for ornament in the East. The following dogwood is indigenous to this state:



**Red-osier Cornel, or Dogwood** (*Cornus stolonifera* Michx.)

A medium-sized or large shrub with reddish-purple branches and white fruits, which are about one-fourth (or less) of an inch in diameter and contain a two-seeded stone. It has small white flowers borne in clusters and leaves which are green above, whitish beneath and two to four inches long.

This shrub occurs on wooded bottom lands more or less throughout the state. It is a pretty shrub and its bright-colored stems and branches make it rather attractive in winter.

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## HEATH FAMILY.

### (Ericaceae).

Among the members of this large family may be mentioned such well-known plants as the trailing arbutus, the azalia, the heather, the bearberry and the American laurel. Many of the shrubs belonging to the heath family are evergreen, and quite a number of them are very ornamental. The family is represented in this state by several low undershrubs, but only the following is of any considerable size:

**Labrador Tea** (*Ledum glandulosum* Nutt.)

An evergreen shrub, two to six feet high, with thick, firm, oblong leaves, whitish beneath, and terminal or lateral clusters of white flowers. The small oblong seed capsules are borne on recurved stalks. This shrub occurs in the mountains of northwestern Wyoming. The Labrador tea of eastern North America is a different species.

## HUCKLEBERRY FAMILY.

### (Vacciniaceae).

The blueberries and cranberries are among the members of this family. Besides the two following shrubby species the dwarf bilberry (*Vaccinium caespitosum* Michx.) and red bilberry (*Vaccinium erythrococcum* Rydb.), often improperly called huckleberry, are found in our mountains.

**Western Bilberry** (*Vaccinium occidentale* A. Gray).

A low much-branched shrub, a foot or more high, with small, oblong leaves, one-half to one inch long. It has small urn-shaped flowers and blackish-blue berries, one-fourth of an inch in diameter. Found in swales in the mountains of western Wyoming.

**Thin-leaved Bilberry** (*Vaccinium membranaceum* Dougl.)

A pale-green shrub, one to several feet high, the leaves thin and oval in outline, one to two inches long. It has globular, somewhat urn-shaped flowers and berries like those of the preceding. It occurs in moist woods in the northwestern part of the state.

## HONEYSUCKLE FAMILY.

### (Caprifoliaceae).

This family contains many desirable ornamental shrubs, chief among which are the honeysuckles. It is represented in this state by quite a number of native species.

The elders (*Sambucus* spp.) may be recognized by their vigorous shoots, having large pith, large leaves of mostly seven leaflets and by the clusters of red or black berry-like fruits. Their showy whitish flowers make them quite attractive and desirable as ornamentals. Three species occur in this state. They grow in moist places in ravines in the foothills and mountains.

**American Elder** (*Sambucus Canadensis* L.)

A useful ornamental shrub, with broad clusters of flowers and purplish black berries. It is rare in Wyoming, being known only from the northeastern part.

The elders are not without some value for their berries for this species, which is more common eastward, are often used by housewives for the manufacture of elderberry wine and for pies. Some improved forms are now being cultivated and it is very probable that a desirable fruit-bearing variety will be developed.

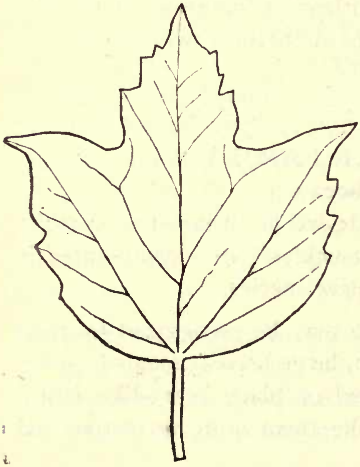
**Rocky Mountain Elder** (*Sambucus melanocarpa* A. Gray).

With black berries and smaller clusters of flowers as high as broad. This species is the common one in the state.

**Red Elder** (*Sambucus pubens* Michx.)

This elder has been found in the northwestern part of the state. It has oblong clusters of flowers and red or scarlet berries.

**High Bush-cranberry** (*Viburnum Opulus* L.)



A medium-sized shrub, with broad, coarsely-toothed, three-lobed leaves, showy white flowers and bright red berries, each containing a single flat stone. It is found in the Black Hills.

This shrub is a handsome ornamental and its berries are esteemed for jelly and sauce. Though already cultivated to some extent for its fruits, it has not as yet given rise to any named varieties.

**Sheepberry** (*Viburnum Lentago* L.)

A shrub or small tree, with long-pointed, sharply-toothed leaves, large clusters of white flowers and oval, black fruits with a bluish bloom. Occurring in Sheridan county. Its fruits are sweet and edible. This is a pretty shrub, useful as an ornamental.

**Wolfberry** (*Symphoricarpos occidentalis* Hook.)

A low shrub very similar to the snowberry, and related to the cultivated coral-berry. It has thickish, oval or oblong leaves, one to two inches long, short, broad pinkish flowers and small white berries borne in the axils of the upper branches. Very common throughout the state. Though not as attractive as the snowberry it may be used to advantage for massing effects, as it suckers freely and soon covers the ground.

**Spreading Wolfberry** (*Symphoricarpos vaccinioides* Rydb.)

Depressed and of a spreading habit of growth, with much smaller leaves (one-half to an inch long) and longer flowers than the preceding. Of frequent occurrence in the hills and mountains.

## HONEYSUCKLE.

### (Lonicera).

The honeysuckles are well-known ornamental climbers or bushy shrubs. We have four bush-honeysuckles in this state, while one climber is known to occur in Crook county.

**Involucred Fly-honeysuckle** (*Lonicera involucrata* (Rich.) Banks).

A low or good-sized shrub with grayish shreddy bark, very ample green foliage and purplish-black twin berries, one-third of an inch in diameter. The yellowish, tubular flowers are subtended by two leaf-like bracts (the involucre), which later nearly enclose the berries.

This is not infrequent on the banks of creeks and rivulets in our hills and mountains. It suckers freely and often forms beds of considerable size.

**Utah Fly-honeysuckle** (*Lonicera Utahensis* Wats.)

A low straggling shrub with slender branches and thin oval or oblong leaves, whitish below, rounded at both ends and an inch or an inch and a half long. It has honey-yellow flowers, often tinged with purple, and red twin berries.

This is a very pretty, delicate shrub which would be desirable in any home lot. It grows in woodlands in the mountains of the western part of the state.

**American Fly-honeysuckle** (*Lonicera ciliata* Muhl.)

Very similar to the preceding, but the leaves pointed and usually slightly hairy on the margins. This shrub is rare in the state, being known only from the foothills ten miles west of Cheyenne.

**Blue Fly-honeysuckle** (*Lonicera caerulea* L.)

A low shrub with erect, stoutish stems, one to three feet high. Its leaves are similar to those of the two preceding, but its yellowish flowers and blue berries are borne on very short stalks. Found in cold boggy swales in the mountains of the extreme western part of the state.

This shrub has numerous varieties in cultivation and is highly esteemed for ornamental planting in the East and also in Europe.

## SUNFLOWER FAMILY.

### (Compositae).

A huge family comprising a great number of annuals and perennial herbs and a few shrubs. Its members may be recognized by their "compound flowers," or more properly speaking flower heads, in which the individual flowers are crowded close together on a common receptacle or disk. The sunflower and the thistle are familiar examples. To this family belong such well-known plants as the chrysanthemum, tansy, golden rod, aster, daisy, yarrow and artichoke. Plants classed in this family abound in this state.

A number of native shrubs and underbushes of the state, such as the sage-brushes and rabbit-bushes, belong to the thistle family. These shrubs have very small flowers little resembling those of the thistle or the sunflower.

## TETRADYMIA.

### (Tetradymia).

The tetradymias are low grayish shrubs with yellow flowers clustered at the ends of the branches. They grow naturally on open plains and especially in desert regions. The seeds, which are borne several together in each flower head, are surmounted by numerous long white bristles.

**Gray Tetradymia** (*Tetradymia canescens* DC.)

The common species throughout the state. The whole plant is gray in color. The leaves are narrow and less than an inch long and the yellow flower heads are very numerous at the ends of the branches.

**Nuttall's Tetradymia** (*Tetradymia Nuttallii* T. & G.)

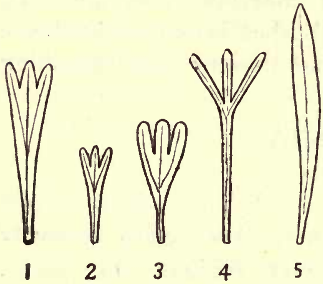
A low rigid shrub with spiny branches, the short, blunt-pointed leaves arising in tufts. The slender spines are a half to an inch in length, and its flower heads are closely crowded together at the ends of the branches. This shrub occurs in the arid region of southwestern Wyoming.

**Spiny Tetradymia** (*Tetradymia spinosa* H. & A.)

A scraggy shrub with woolly branches and very small tufted green leaves. Its spines are only about one-third of an inch in length and the flowers (heads), which are white-woolly on the exterior, are borne singly on stoutish stalks along the branches. Not uncommon in the Red Desert. This white-stemmed shrub is rather pretty and of striking appearance.

## SAGE-BRUSH.

### (Artemisia).



Leaves of the Sage-Brushes—1. Common Sage-brush. 2. Matted Sage-brush. 3. Low Sage-brush. 4. Mountatn Sage-brush. 5. Hoary Sage-brush.

The genus *Artemisia*, to which the sage-brushes belong, also includes the common wormwoods, The sage-brushes, of which there are five in this state, are low grayish shrubs very common in valleys and on prairies, especially on plains adjacent to the foothills. They may be known by their characteristic bitter-aromatic odor and by their minute greenish-yellow flowers, which are very numerous on the shoots of the season.

**Common Sage-brush** (*Artemisia tridentata* Nutt.)

Readily known by its wedge-shaped leaves, three-toothed at the apex. Though only one to three feet high on the plains it is much taller in the rich soil of draws and valleys, and in rare cases attains the size of a small tree.

**Matted Sage-brush** (*Artemisia nova* Aven Nelson).

Resembling the common sage-brush, but very low and matted, forming more or less extensive patches on exposed slopes. The leaves are greenish in color and much smaller than those of the preceding.

**Low Sage-brush** (*Artemisia arbuscula* Nutt.)

A low shrub, less than a foot high, with wedge-shaped, three-lobed leaves and less numerous flowers than the two preceding sage-brushes. Infrequent in the state; occurring in southern and southwestern Wyoming.

**Mountain Sage-brush** (*Artemisia tripartita* Rydb.)

A low, more or less matted, grayish-white shrub, usually less than a foot high. It may be distinguished from other sage-brushes by its leaves which are divided nearly half way into three very narrow lobes. Common on bleak slopes and ridges in the lower mountains.

**Hoary Sage-brush** (*Artemisia cana* Pursh).

A common shrub in clayey soil on the plains. It is one or two feet high and has narrow entire leaves which are silvery-hoary or greenish in color and an inch or two long.

### RABBIT-BUSH.

### (Chrysothamnus).

The rabbit-bushes are characteristic low shrubs or undershrubs of our open plains. They are often improperly called sage-brush, but as they lack the well-known scent of the sage-brush they need not be confused with them. The rabbit-bushes all have narrow leaves and yellow flowers produced in great abundance at the ends of the stems, literally covering the bushes or clumps during August and early September. On account of the large masses of yellow flowers some of them may be used to advantage for bedding purposes. The ornamental rabbit-bush (*Chrysothamnus pulcherrimus*) is especially handsome, producing a wealth of yellow flowers equaled by no other native shrub. The foothill rabbit-bush is also a desirable species.

There is a great variety of these undershrubs in the state. The more shrubby ones are given below. Most of them have more or less hoary leaves and greenish-yellow or yellow branches, which are usually very minutely woolly under a magnifying glass. The first three, however, have smooth whitish stems and very green leaves.

**Green Rabbit-bush** (*Chrysothamnus pumilus* Nutt.)

Very low and seldom over a foot high. The abundant flowers are crowded into rounded clusters at the ends of the branches, and its leaves are green and very narrow. A common species on the plains.

**Foothill Rabbit-bush** (*Chrysothamnus glaucus* Aven Nelson).

Similar to the preceding, but larger in every way, one to three feet high, and with long leaves from an eighth to one-fourth of an inch broad. Common in rocky ravines in the foothills of Albany county.

**Desert Rabbit-bush** (*Chrysothamnus linifolius* Greene).

An erect shrub, two to five feet high, occurring on moist alkali flats in the Red Desert and adjacent localities. Its trusses of flowers are flat-topped, and its leaves are shorter but as broad as those of the preceding.

**Strong-scented Rabbit-bush** (*Chrysothamnus graveolens* (Nutt.) Greene).

This and the three following are very similar, being two to several feet high and having yellowish stems and very narrow (linear) leaves one and a half to three inches long. This species has large flat-topped trusses of flowers and its leaves are not at all hoary. It is common in eastern Wyoming.

**Rock Rabbit-bush** (*Chrysothamnus oreophilus* Aven Nelson).

Like the preceding, but the flower clusters smaller and not as flat-topped and its green leaves are less than two inches long. It occurs in the southern part of Uinta county.

**Ornamental Rabbit-bush** (*Chrysothamnus pulcherrimus* Aven Nelson).

This rabit-bush has long hoary leaves and stout erect branches terminated by large trusses of light-yellow flowers. It is common in southern and western Wyoming.

**Wyoming Rabbit-bush** (*Chrysothamnus Wyomingensis* Aven Nelson).

Fewer-flowered and leaves less hoary than in the preceding. Its flowers are arranged along the upper part of the branches. This species is widely distributed in the state.

**Hoary Rabbit-bush** (*Chrysothamnus Plattensis* Greene).

Very low and seldom over a foot high. It has yellowish stems and hoary-gray leaves. It is very common on the high plains of southern Wyoming and especially abundant on the alkali flats of the Laramie plains.

**Howard's Rabbit-bush** (*Chrysothamnus Howardii* (Parry) Greene).

A low but stoutish and much-branched species with yellowish stems, hoary leaves and few comparatively large but inconspicuous flowers. It occurs on rocky banks in southern Wyoming.

**Parry's Rabbit-bush or False Golden-rod** (*Chrysothamnus Parryi* (A. Gray) Greene).

A small shrub, one to two feet high, with yellowish gray stems and long and very narrow green leaves. The heads, which are very much larger than those of the other rabbit-bushes, are arranged along the upper part of the branches. This species occurs on open slopes and in parks of the Medicine Bow mountains.

# Abbreviations.

| | |
|---|---|
| A. Gray | Asa Gray |
| Anders. | N. J. Anderson |
| Burgsd. | F. A. L. von Burgsdorff |
| C. & S. | A. von Chamisso and D. F. L. von Schlechtendahl |
| DC. | A. P. DeCandolle |
| Dougl. | D. Douglas |
| Hook. | W. J. Hooker |
| H. & A. | W. J. Hooker and G. A. W. Arnott |
| L. | Carolus Linnaeus or Carl von Linné |
| L. f. | Carl von Linné (the son) |
| L'Her. | C. L. L'Heritier de Brutelle |
| Lindl. | J. Lindley |
| Lodd. | C. Loddiges |
| Michx. | A. Michaux |
| Mill. | P. Miller |
| Moq. | A. Moquin-Tandon |
| Muhl. | H. L. Muhlenberg |
| Nutt. | T. Nuttall |
| Pers. | C. H. Persoon |
| Raf. | C. S. Rafinesque-Schmaltz |
| Rich. | J. Richardson |
| Roem. | J. J. Roemer |
| Rydb. | P. A. Rydberg |
| Sarg. | C. S. Sargent |
| Schwein. | L. D. von Schweinitz |
| Spreng. | K. Sprengel |
| Sudw. | G. B. Sudworth |
| Torr. | J. Torrey |
| T. & G. | J. Torrey and Asa Gray |
| Wats. | S. Watson |

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Walter Mulford

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UNIVERSITY OF WYOMING

# Agricultural Experiment Station

LARAMIE, WYOMING.

## BULLETIN NO. 100

SEPTEMBER, 1913

# Meteorology for Twenty Years

By HENRY G. KNIGHT and J. C. FITTERER

Bulletins will be sent free upon request. Address Director Experiment Station, Laramie, Wyoming.

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# Meteorology for Twenty Years

HENRY G. KNIGHT AND J. C. FITTERER

Meteorological observations have been taken at the Wyoming Agricultural Experiment Station since 1891, and, although the period covered is comparatively short, the data obtained will give some general knowledge of the climatic conditions prevailing over this section of the Laramie plains during the past, and will form a basis for judgment as to what may be expected in the future. As the Laramie plains are now being covered with irrigation projects and many new settlers are coming in, to do general farming, this knowledge of the climate of the country is of importance, for upon the general weather conditions prevailing throughout the year and particularly during the growing season, depend the kinds, and, in a large measure, the quantity and quality of the crops. Upon the climate depends the prosperity of the section in an agricultural way. More depends upon this than upon the soil itself, for with our present scientific knowledge most soils may be made productive if they are infertile, but we cannot change the climate materially. Consequently those contemplating farming operations in a territory unfamiliar to them, should not only make a careful examination of the soil of the land upon which they expect to locate, but a careful study should also be made of the climatology.

It is unfortunate that most prospective settlers in a new country will invariably ask questions about soil conditions and markets while a small minority will ask a few questions regarding climate. Rainfall, humidity, sunshine, average temperatures, range of temperatures, etc., throughout the year and during the growing season should all be quite well known before deciding upon a location.

If alfalfa is to be the principal crop the climate need not be that required for corn. Everyone knows that cotton will not thrive well in the northern states, although we have soils similar to the cotton soils of the south. Here the climate determines largely the profitable crop rather than the soil conditions.

Climate in a mountainous section may vary markedly. Altitude changes very rapidly and the changes in the contour of the country have a remarkable effect upon the precipitation and temperature. The lofty mountains and snow-clad peaks may protect one section while acting as a very menace to another, sending down icy blasts which are death to the tender agricultural plants. Sections of the country at the same altitudes only a few miles apart may show a marked difference in time in the opening of the growing season. Differences in air drainage is very marked in mountainous regions and adjoining farms and even neighboring fields and sections of the same field may be several days apart in the opening and closing of the growing season. These are reasons why climate should be given as careful study and made a subject of as close investigation as the soil. To give more accurate data in field research weather records are kept.

The meteorological instruments of the University of Wyoming Agricultural Experiment Station are at Laramie, at an altitude of approximately 7190 feet above sea level. They are the usual instruments specified by the Weather Bureau of the United States Department of Agriculture. They are described in Wyoming Experiment Station Bulletin No. 4, "Meteorology for 1891," and in Bulletin No. 250, "Instructors for Voluntary Observers," Weather Bureau, United States Department of Agriculture. In some cases modified forms are used for convenience.

To better understand something of the local conditions of weather in this section of the country a brief description of the physical features would not be out of place.

To the eastward of Laramie the land rises rapidly to the Laramie Mountains with an altitude of from 1500 to 1800 feet above the city. The general direction of this range is north and south connecting with a spur of the Medicine Bow range about twenty miles to the south of Laramie.

The Medicine Bow range proper lies thirty or forty miles west of the city, making of the Laramie plains a basin with high elevations on the three sides. This, as would be expected, has a marked effect upon the precipitation throughout this district. Marked differences may be noted in a single storm over the valley and in the surrounding foot hills varying from no precipitation to veritable cloud-bursts. Storms will often form in the mountains to the west, follow the range to the south and east and dissipate themselves before reaching the valley. Storms may stretch from the Medicine Bow range to the west, cross the valley to the north of the city of Laramie and break on the mountains to the east. It is difficult, if not impossible, to predict the course which storms will follow because of shifting of the general directions of the winds.

In 1893 the precipitation in the mountains surrounding the Laramie Plains was normal, while the precipitation at Laramie for the period was only 3.84 inches.

Precipitation and other factors determining climtae show marked changes over this territory. This is by no means peculiar to this section of the country. Other sections, mountain locked, show similar differences.

At high altitudes there is generally a marked difference in temperature between the days and nights throughout the year. The maximum and minimum temperatures are very far apart, which greatly lowers the average daily temperature. Even during the summer months when the high temperature in the sun is rather disagreeable, the temperature will usually fall at night so that warm clothing is needed. Although the mean annual temperature at Laramie approaches that of the far north, this tells only half the truth, because of this range.

In the light of the above stated fact it can be readily understood that the meteorological observations taken at Laramie can not be taken as applying over the Laramie Plains except in a general way, and in comparison with summarized data from lower altitudes may be grossly misinterpreted.

In comparison with data obtained elsewhere daily and annual ranges of some of the important data should be known and carefully compared.

## PRECIPITATION.

To the farmer and stockman the two most important data are the records of precipitation and temperature. With a knowledge of these important factors the general climatic conditions of the country are fairly well fixed in mind.

The records of the precipitation at Laramie show some interesting features. The variation from year to year has been very marked, ranging from 3.84 inches in 1893, to 13.53 inches in 1908. The heaviest precipitation falls during the growing season, May having the heaviest, while July is a close second. November is the dryest month of the year. (See Table 1 and Figures 1 and 2.)

Practically all of the precipitation from the latter part of September to the middle of April falls as snow, while a large portion of the April and some of the May precipitation is snow. While heavy snows may occur at times during the winter months, the average snow fall is quite light. A large part of the winter's snow fall occurs during or is followed by high winds so that drifting is the rule, thus ordinarily leaving portions of the range bare. Usually the plains are bare throughout the winter except for the snow which has drifted into sheltered places. That a direct comparison may be made, the average monthly precipitation of a number of other points in the state where observations have been made covering several years are illustrated by figures taken from data published by the United States Department of Agriculture, Weather Bureau, Summary of the Climatological Data for the United States, Sections 23, 24 and 25.

## TEMPERATURE.

The highest temperature recorded at Laramie for twenty years was 92 degrees in 1901. Ninety degrees was recorded only three separate times so that it may readily be understood that it does not get excessively warm. Eighty-five degrees is about the maximum during the summer months. The lowest temperture recorded during the same period was —42 degrees, while —40 degrees was recorded at another time. The average of the highest temperatures recorded is 87.3 degrees, while the average of the lowest temperature is —23.3 degrees; *i. e.,* we may expect then throughout the year the thermometer will register 87.3 and —23.3 degrees. The mean maximum temperature, taking the mean of the highest temperature recorded each day throughout the year, is 53.6 degrees, while the mean minimum obtained in like manner is 27.7 degrees. The mean temperature for the twenty years is 40.6 degrees.

By months July gives the average highest temperature with a mean maximum of 77.10 degrees, while the three winter months give the lowest of 33.3 degrees for January and 33.4 degrees for February and December, respectively.

The mean temperature for July is 62.4 degrees, which is the highest, while February gives the lowest, 21.9 degrees.

July gives the highest mean maximum temperature, 47.9 degrees, while February gives the lowest, 10.5 degrees. The temperature tables and figures give details for the various months of the twenty years, so that one will be able to know by studying them what the average expectation is.

## HUMIDITY OF ATMOSPHERE.

The humidity records give the relative degree of saturation of the atmosphere. Air saturated with moisture as is usually the case when it has been snowing or raining for some time, contains all the moisture it will hold at that temperature and the relative humidity is said to be 100—*i. e.*, contains 100 per cent of all the moisture it will hold without precipitating more. The relative humidity of the air in a fog is always 100. On the other hand, air containing absolutely no moisture will have a relative humidity of 0. The humidity of the atmosphere may range all the way from near zero to 100, depending upon conditions. In a climate such as exists over the Laramie Plains, with a rather light precipitation, we would naturally expect a very dry air and we find this to be true. The average relative humidity at Laramie for twenty years is 61.4. In other words, the air is only about two-thirds saturated with moisture throughout the year. The atmosphere in June is only a little more than half saturated with water vapor, having a relative humidity of 55.2. February has the highest relative humidity, 69.6.

The fact that the air is so dry has a marked effect upon the evaporation. Evaporation is much in excess of the precipitation.

## SUNSHINE.

The sunshine records were not complete so are not published. The percentage of sunshine is very high, as is also the number of clear days as compared to the cloudy and partly cloudy days.

TABLE I.—PRECIPITATION AT LARAMIE FOR 20 YEARS.

| YEARS | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1891 | 0.70 | 0.38 | 1.50 | 0.25 | 2.92 | 0.91 | 1.20 | 1.76 | 1.80 | 0.30 | 1.09 | 1.11 | 13.92 |
| 1892 | 0.01 | 0.36 | 0.52 | 0.19 | 1.16 | 3.97 | 2.22 | 0.14 | T | 3.96 | T | 0.20 | 12.73 |
| 1893 | T | 0.11 | 0.29 | 0.32 | 0.33 | 0.54 | 0.34 | 1.08 | 0.39 | 0.28 | 0.06 | 0.10 | 3.84 |
| 1894 | 0.03 | 0.10 | 0.29 | 1.51 | 0.42 | 0.64 | 1.41 | 1.26 | 1.60 | 0.09 | 0.05 | 0.23 | 7.63 |
| 1895 | 0.08 | 0.14 | 0.43 | 0.87 | 2.09 | 2.12 | 2.71 | 1.17 | 0.18 | 0.74 | 0.32 | 0.33 | 11.15 |
| 1896 | 0.44 | 0.17 | 0.59 | 3.53 | 2.37 | 1.72 | 1.66 | 0.89 | 1.16 | 0.18 | 0.09 | T | 12.80 |
| 1897 | 0.39 | 0.35 | 4.23 | 0.55 | 1.85 | 0.72 | 1.29 | 1.11 | 0.32 | 0.55 | 0.33 | 0.77 | 12.48 |
| 1898 | 0.05 | 0.01 | 0.40 | 1.26 | 1.88 | 0.90 | 0.65 | 1.16 | T | 0.48 | 0.61 | 0.23 | 7.63 |
| 1899 | 0.95 | 1.13 | 1.11 | 1.75 | 0.37 | 1.11 | 2.01 | 1.43 | 0.17 | 1.13 | 0.07 | 0.61 | 11.84 |
| 1900 | 0.01 | 0.82 | 0.58 | 2.91 | 0.24 | 0.35 | 1.25 | 0.61 | 1.11 | 0.56 | 0.06 | 0.03 | 8.53 |
| 1901 | 0.04 | 0.41 | 0.05 | 0.28 | 3.00 | 1.73 | 0.32 | 1.11 | 0.09 | 1.28 | T | 0.21 | 8.52 |
| 1902 | T | 0.26 | 0.41 | 0.88 | 0.26 | 0.60 | 1.49 | 0.40 | 1.58 | 0.74 | 0.22 | 0.89 | 7.73 |
| 1903 | 0.11 | 0.36 | 1.09 | 0.73 | 1.63 | 1.00 | 1.31 | 0.88 | 2.37 | 0.54 | 0.30 | 0.07 | 10.37 |
| 1904 | 0.25 | 0.11 | 0.36 | 0.84 | 1.74 | 2.01 | 1.33 | 0.93 | 1.35 | 0.50 | 0.04 | 0.08 | 9.53 |
| 1905 | 0.39 | 0.42 | 0.64 | 1.21 | 1.79 | 0.36 | 1.79 | 0.83 | 1.62 | 0.46 | 0.22 | 0.03 | 9.76 |
| 1906 | 0.58 | 0.05 | 1.01 | 1.75 | 0.91 | 1.71 | 1.75 | 0.59 | 2.09 | 1.33 | 0.41 | 0.39 | 12.57 |
| 1907 | 0.29 | 0.15 | 0.28 | 0.78 | 1.09 | 0.90 | 3.68 | 1.28 | 0.62 | 0.16 | T | 0.23 | 9.46 |
| 1908 | 0.24 | 0.08 | 0.02 | 0.34 | 5.57 | 0.84 | 2.68 | 1.93 | 0.65 | 0.45 | 0.38 | 0.35 | 13.53 |
| 1909 | .34 | .27 | 1.11 | .76 | 1.66 | .67 | 1.00 | 1.87 | .97 | .50 | .29 | .24 | 9.08 |
| 1910 | 0.19 | 0.04 | 0.33 | 0.95 | 1.90 | 1.52 | 1.97 | 0.27 | 1.11 | 1.79 | 0.06 | 0.32 | 10.45 |
| Sum | 5.09 | 5.72 | 15.24 | 21.66 | 33.18 | 24.32 | 32.06 | 20.70 | 19.20 | 16.02 | 4.60 | 6.42 | 204.20 |
| Means | .25 | .29 | .76 | 1.09 | 1.66 | 1.22 | 1.61 | 1.03 | .96 | .80 | .23 | .32 | 10.21 |

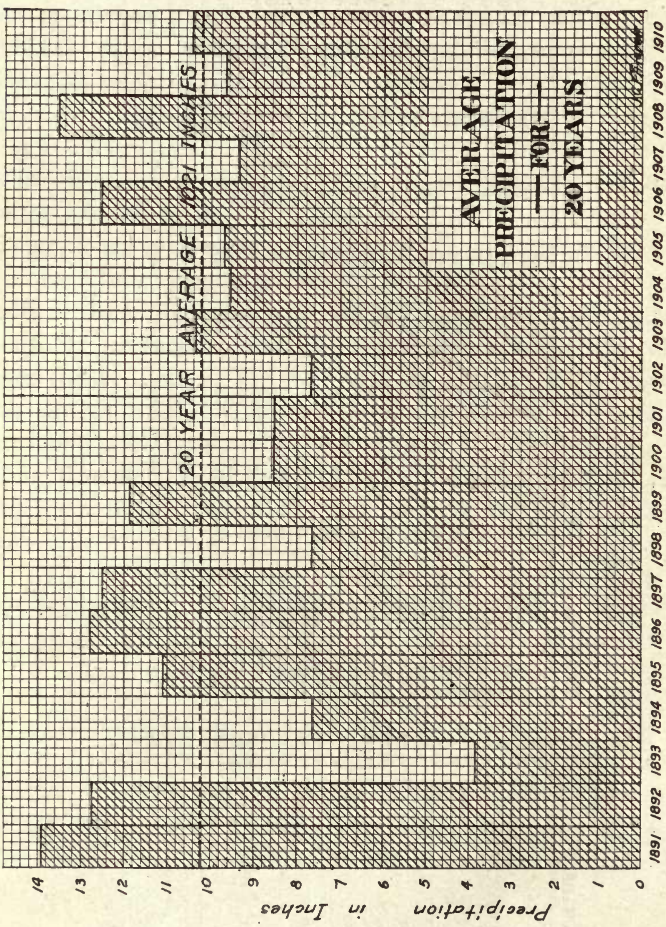


Fig. 1.—Precipitation by years at Laramie, Wyoming, for a period of twenty years. The annual precipitation has varied quite markedly during the 20-year period, 1891-1910; the first ten years of this period showing the greater variation.

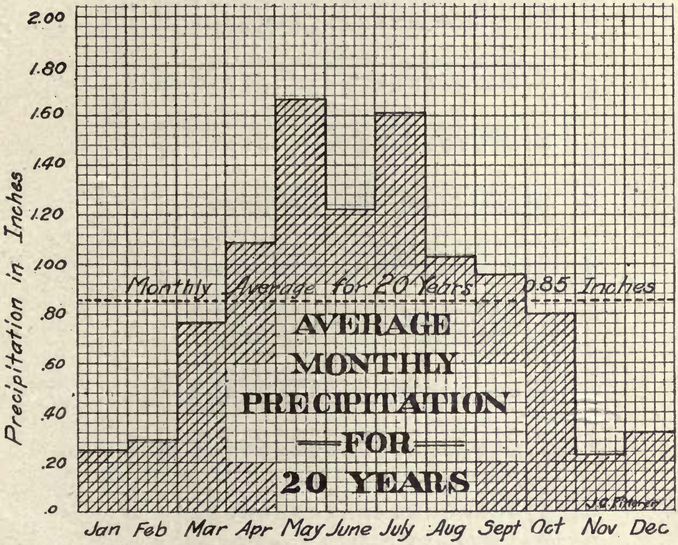


Fig. 2.—Average monthly precipitation at Laramie, for twenty years. The heaviest precipitation comes during the growing season.

TABLE II.—TEMPERATURE MEANS AT LARAMIE FOR 20 YEARS.

| YEARS | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Sums | Means | High'st | Lowest |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1891………… | 20.2 | 23.3 | 25.6 | 40.5 | 54.5 | 58.4 | 61.2 | 61.0 | 55.1 | 43.2 | 28.6 | 19.6 | 491.2 | 40.9 | 83 | —13 |
| 1892………… | 20.6 | 25.2 | 30.8 | 35.5 | 44.4 | 55.7 | 62.8 | 61.9 | 56.0 | 39.2 | 33.1 | 20.7 | 485.9 | 40.4 | 86 | —29 |
| 1893………… | 26.8 | 20.7 | 28.8 | 34.2 | 44.2 | 57.2 | 64.0 | 60.7 | 52.8 | 42.3 | 29.2 | 26.6 | 487.5 | 40.6 | 87 | —9 |
| 1894………… | 19.9 | 16.2 | 29.4 | 31.1 | 50.0 | 55.8 | 63.2 | 62.2 | 51.8 | 44.4 | 36.8 | 21.5 | 482.3 | 40.2 | 88 | —27 |
| 1895………… | 20.5 | 17.9 | 27.5 | 40.0 | 45.3 | 52.2 | 58.8 | 61.6 | 54.5 | 40.9 | 27.0 | 15.3 | 461.5 | 38.4 | 87 | —30 |
| 1896………… | 28.0 | 22.8 | 26.2 | 37.4 | 47.3 | 59.1 | 62.3 | 61.9 | 52.6 | 41.9 | 26.3 | 31.4 | 497.2 | 42.3 | 85 | —21 |
| 1897………… | 16.5 | 21.2 | 24.3 | 35.0 | 49.3 | 55.6 | 60.7 | 60.4 | 56.8 | 42.3 | 34.8 | 15.0 | 471.9 | 39.3 | 85 | —30 |
| 1898………… | 17.0 | 25.5 | 24.7 | 40.3 | 44.1 | 56.8 | 65.1 | 62.9 | 51.9 | 39.3 | 23.1 | 14.3 | 465.0 | 38.7 | 88 | —23 |
| 1899………… | 20.6 | 10.5 | 24.5 | 38.3 | 45.5 | 55.8 | 62.1 | 60.8 | 55.1 | 39.1 | 35.7 | 18.8 | 466.8 | 38.9 | 87 | —40 |
| 1900………… | 25.7 | 19.7 | 32.2 | 35.9 | 50.8 | 61.5 | 62.8 | 62.3 | 51.8 | 45.1 | 38.5 | 25.8 | 512.1 | 42.7 | 91 | —27 |
| 1901………… | 19.3 | 19.4 | 26.5 | 34.5 | 49.5 | 53.6 | 67.8 | 62.7 | 52.4 | 44.4 | 37.1 | 20.9 | 488.1 | 40.7 | 92 | —23 |
| 1902………… | 22.2 | 28.9 | 27.5 | 38.6 | 49.0 | 58.0 | 59.9 | 57.4 | 51.5 | 44.3 | 32.6 | 24.5 | 494.4 | 41.2 | 91 | —18 |
| 1903………… | 23.3 | 11.5 | 29.3 | 37.5 | 43.9 | 53.9 | 62.7 | 63.1 | 51.2 | 43.3 | 34.8 | 26.4 | 480.9 | 40.0 | 84 | —26 |
| 1904………… | 20.2 | 29.7 | 32.5 | 38.5 | 46.8 | 54.0 | 60.5 | 61.5 | 54.3 | 42.2 | 35.5 | 26.2 | 501.9 | 41.8 | 84 | —16 |
| 1905………… | 23.1 | 15.5 | 34.6 | 35.6 | 44.6 | 58.3 | 61.4 | 62.9 | 54.9 | 37.4 | 33.0 | 22.2 | 483.3 | 40.3 | 91 | —42 |
| 1906………… | 24.5 | 27.5 | 24.7 | 39.8 | 47.4 | 55.1 | 60.3 | 61.6 | 53.7 | 40.3 | 29.1 | 30.0 | 494.0 | 41.2 | 88 | —21 |
| 1907………… | 24.7 | 32.9 | 36.1 | 37.1 | 42.2 | 53.5 | 62.6 | 61.5 | 53.7 | 44.7 | 30.1 | 23.5 | 502.6 | 41.8 | 85 | —9 |
| 1908………… | 19.7 | 24.5 | 33.8 | 41.8 | 44.6 | 54.4 | 61.4 | 60.3 | 54.9 | 39.5 | 25.5 | 23.3 | 483.7 | 40.6 | 86 | —24 |
| 1909………… | 28.1 | 23.5 | 28.7 | 32.5 | 43.2 | 57.2 | 65.0 | 64.0 | 53.0 | 45.0 | 36.0 | 13.6 | 489.8 | 40.8 | 90 | —23 |
| 1910………… | 24.1 | 21.5 | 39.4 | 40.5 | 46.9 | 60.0 | 64.5 | 62.0 | 55.0 | 45.0 | 38.0 | 26.0 | 522.9 | 43.5 | 89 | —14 |
| Sums………… | 445.0 | 437.9 | 587.1 | 744.6 | 933.5 | 1126.1 | 1249.1 | 1232.8 | 1073.0 | 843.8 | 644.7 | 445.6 | 9763.1 | 814.3 | 1747 | —465 |
| Means………… | 22.2 | 21.9 | 29.3 | 37.2 | 46.6 | 56.3 | 62.4 | 61.6 | 53.6 | 42.2 | 32.2 | 22.2 | 487.7 | 40.6 | 87.3 | —23.3 |

### TABLE III.—HIGHEST TEMPERATURES AT LARAMIE FOR 20 YEARS.

| YEARS | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Sums | Means |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1891 | 43 | 53 | 50 | 73 | 76 | 82 | 80 | 83 | 72 | 68 | 66 | 44 | 790 | 65.8 |
| 1892 | 52 | 49 | 54 | 66 | 71 | 83 | 85 | 86 | 81 | 79 | 56 | 51 | 813 | 67.8 |
| 1893 | 51 | 49 | 64 | 62 | 76 | 85 | 87 | 85 | 79 | 68 | 57 | 47 | 810 | 67.5 |
| 1894 | 54 | 42 | 60 | 66 | 77 | 81 | 88 | 85 | 78 | 70 | 62 | 51 | 814 | 67.8 |
| 1895 | 50 | 55 | 64 | 67 | 75 | 78 | 87 | 86 | 83 | 70 | 59 | 45 | 819 | 68.2 |
| 1896 | 57 | 52 | 61 | 67 | 76 | 85 | 82 | 85 | 80 | 75 | 60 | 56 | 836 | 69.6 |
| 1897 | 48 | 47 | 56 | 67 | 74 | 82 | 85 | 83 | 83 | 73 | 64 | 45 | 807 | 67.2 |
| 1898 | 48 | 49 | 52 | 74 | 73 | 88 | 88 | 86 | 79 | 72 | 61 | 45 | 815 | 68.0 |
| 1899 | 46 | 43 | 52 | 65 | 72 | 87 | 87 | 83 | 85 | 76 | 59 | 48 | 803 | 67.0 |
| 1900 | 50 | 44 | 63 | 65 | 78 | 91 | 89 | 89 | 83 | 70 | 62 | 53 | 837 | 69.8 |
| 1901 | 48 | 48 | 56 | 70 | 74 | 87 | 92 | 86 | 79 | 72 | 62 | 50 | 824 | 68.6 |
| 1902 | 52 | 54 | 52 | 69 | 75 | 87 | 89 | 91 | 80 | 71 | 63 | 52 | 835 | 69.5 |
| 1903 | 44 | 42 | 58 | 66 | 75 | 84 | 84 | 84 | 82 | 71 | 62 | 52 | 804 | 67.0 |
| 1904 | 50 | 56 | 57 | 69 | 73 | 79 | 83 | 84 | 83 | 70 | 61 | 55 | 820 | 68.3 |
| 1905 | 47 | 52 | 57 | 67 | 72 | 83 | 91 | 90 | 81 | 73 | 61 | 56 | 830 | 69.1 |
| 1906 | 52 | 54 | 58 | 69 | 74 | 84 | 82 | 88 | 81 | 73 | 58 | 56 | 829 | 69.0 |
| 1907 | 52 | 55 | 67 | 67 | 73 | 78 | 85 | 84 | 80 | 75 | 61 | 56 | 833 | 69.4 |
| 1908 | 45 | 54 | 64 | 69 | 74 | 80 | 84 | 86 | 84 | 71 | 62 | 47 | 820 | 68.3 |
| 1909 | 49 | 54 | 55 | 69 | 68 | 86 | 90 | 88 | 79 | 75 | 67 | 46 | 826 | 68.8 |
| 1910 | 50 | 50 | 68 | 76 | 77 | 85 | 89 | 86 | 80 | 82 | 60 | 55 | 858 | 71.5 |
| Sums | 988 | 1002 | 1168 | 1363 | 1483 | 1675 | 1727 | 1718 | 1612 | 1454 | 1223 | 1010 | 16423 | 1368.2 |
| Means | 49.4 | 50.1 | 58.4 | 68.1 | 74.1 | 83.7 | 86.3 | 85.9 | 80.6 | 72.7 | 61.1 | 50.5 | 820.9 | 68.4 |

TABLE IV.—MEAN MAXIMUM TEMPERATURES AT LARAMIE FOR 20 YEARS.

| YEARS | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Sums | Means |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1891 | 30.6 | 32.8 | 36.5 | 52.5 | 63.2 | 71.2 | 74.6 | 74.5 | 68.5 | 58.3 | 41.6 | 30.9 | 635.2 | 52.9 |
| 1892 | 30.5 | 34.9 | 40.0 | 46.1 | 55.7 | 69.6 | 76.3 | 77.9 | 73.4 | 52.5 | 42.2 | 30.0 | 629.1 | 52.4 |
| 1893 | 37.8 | 31.2 | 39.1 | 45.0 | 57.1 | 73.6 | 79.4 | 74.7 | 69.3 | 54.5 | 40.4 | 35.1 | 637.2 | 53.1 |
| 1894 | 29.9 | 27.7 | 39.3 | 50.7 | 62.9 | 70.1 | 77.7 | 77.1 | 66.4 | 57.6 | 49.5 | 33.4 | 642.3 | 53.5 |
| 1895 | 30.0 | 29.7 | 38.4 | 52.7 | 56.6 | 64.9 | 72.2 | 75.1 | 70.3 | 55.7 | 37.4 | 25.5 | 608.5 | 50.7 |
| 1896 | 41.5 | 36.3 | 37.6 | 50.7 | 61.2 | 73.6 | 75.8 | 76.8 | 66.2 | 56.4 | 38.5 | 43.8 | 659.4 | 54.9 |
| 1897 | 29 | 34 | 36 | 47 | 64 | 69 | 75 | 75.0 | 72 | 56 | 45 | 26.5 | 628.5 | 52.4 |
| 1898 | 28 | 36 | 39 | 55 | 56 | 72 | 78.6 | 78.9 | 68 | 52 | 35 | 26 | 624.5 | 52.0 |
| 1899 | 30.9 | 21.4 | 33.5 | 49.5 | 57.3 | 68.5 | 76.8 | 75.7 | 72.0 | 50.6 | 49.1 | 30.5 | 615.8 | 51.3 |
| 1900 | 38 | 31 | 45 | 47 | 65 | 78 | 79 | 79.2 | 66.3 | 59.4 | 47.2 | 37.8 | 672.9 | 56.1 |
| 1901 | 28.0 | 32.5 | 37 | 46.0 | 63 | 66.9 | 83.1 | 75.9 | 68.4 | 58.7 | 50.4 | 31 | 640.9 | 53.4 |
| 1902 | 34.5 | 38.6 | 37.5 | 52.1 | 63.1 | 73.7 | 75.1 | 77.8 | 66.9 | 57 | 43.7 | 33.3 | 653.3 | 54.4 |
| 1903 | 34 | 21.5 | 40.7 | 48.7 | 56.5 | 66.8 | 77.4 | 78.4 | 64.3 | 57.2 | 46.7 | 37.7 | 629.9 | 52.5 |
| 1904 | 30.7 | 39.1 | 44.2 | 51.4 | 59.0 | 67.6 | 75.1 | 76.9 | 70.1 | 57.6 | 51.7 | 37.4 | 660.8 | 55.1 |
| 1905 | 33.6 | 28.6 | 45.3 | 47.2 | 56.1 | 73.7 | 76.4 | 79.1 | 70.1 | 50.5 | 46.6 | 34.5 | 640.7 | 53.4 |
| 1906 | 37 | 40 | 36 | 52 | 61 | 70 | 74 | 78 | 68 | 54 | 41 | 41 | 652.0 | 54.3 |
| 1907 | 37 | 45 | 48 | 50 | 53 | 68 | 78 | 76 | 69 | 60 | 45 | 36 | 665 | 55.4 |
| 1908 | 31.4 | 39.3 | 47.5 | 57 3 | 57.5 | 68.5 | 75.4 | 73.6 | 71.6 | 52.4 | 39.5 | 35.2 | 649.2 | 53.3 |
| 1909 | 39.6 | 35.8 | 40.4 | 44.6 | 56.2 | 71.6 | 81 | 79 | 68 | 61 | 48 | 25.9 | 651.1 | 54.2 |
| 1910 | 34.5 | 33.0 | 54.6 | 57.0 | 59.8 | 75.5 | 79.9 | 78 | 71 | 59 | 51 | 37 | 690.3 | 57.5 |
| Sums | 666.5 | 668.4 | 815.6 | 1002.5 | 1184.2 | 1412.8 | 1540.8 | 1537.6 | 1379.8 | 1120.4 | 889.5 | 668.5 | 12886.6 | 1072.8 |
| Means | 33.3 | 33.4 | 40.8 | 50.1 | 59.2 | 70.6 | 77.1 | 76.8 | 68.9 | 56.0 | 44.5 | 33.4 | 644.1 | 53.6 |

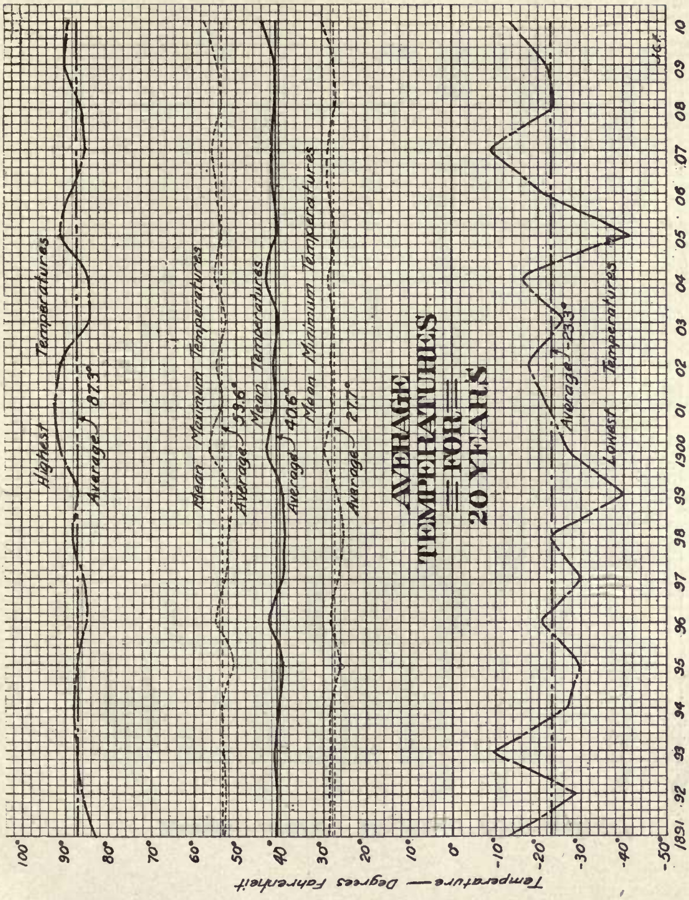


Fig. 3.—Average temperatures at Laramie for 20 years.

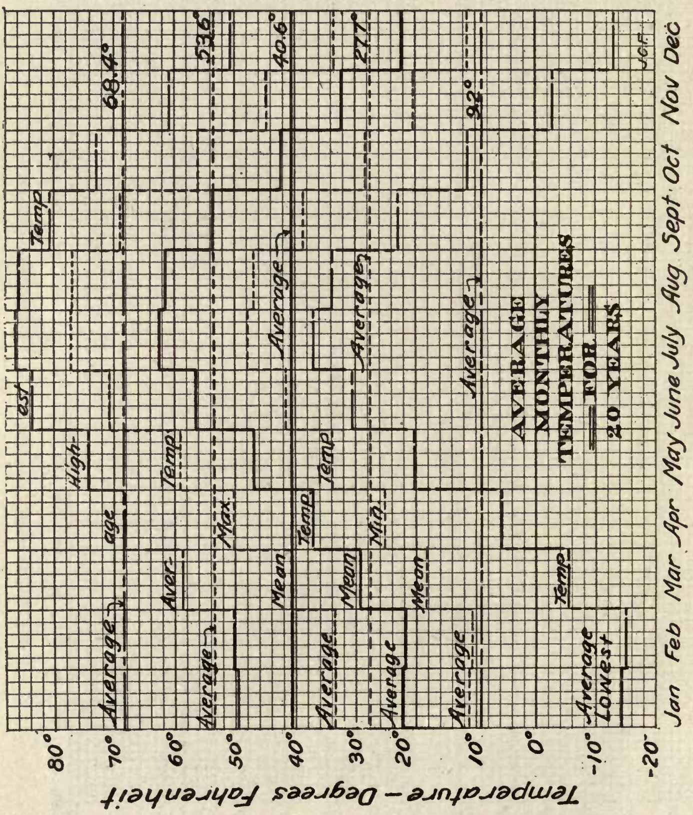


Fig. 4.—Average monthly temperatures at Laramie for 20 years.

TABLE V.—LOWEST TEMPERATURES AT LARAMIE FOR 20 YEARS.

| YEARS | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Sums | Means |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1891 | —7 | 0 | —10 | 7 | 28 | 31 | 36 | 34 | 30 | 14 | —13 | —13 | 137 | 11.4 |
| 1892 | —29 | —13 | —2 | 11 | 25 | 29 | 40 | 30 | 23 | 11 | 8 | —16 | 117 | 9.7 |
| 1893 | —7 | —9 | —1 | 9 | 15 | 28 | 39 | 32 | 23 | 10 | —6 | —2 | 131 | 10.9 |
| 1894 | —25 | —24 | —5 | 7 | 23 | 33 | 42 | 35 | 29 | 16 | —15 | —27 | 89 | 7.4 |
| 1895 | —14 | —30 | —6 | 13 | 25 | 26 | 34 | 36 | 9 | 10 | —4 | —16 | 83 | 6.9 |
| 1896 | —2 | —19 | —21 | 2 | 20 | 32 | 41 | 36 | 23 | 17 | —21 | 2 | 110 | 9.2 |
| 1897 | —30 | —4 | —15 | 5 | 24 | 29 | 32 | 35 | 25 | 5 | 0 | —24 | 82 | 6.8 |
| 1898 | —23 | 2 | —10 | 0 | 20 | 29 | 38 | 38 | 19 | 7 | —12 | —22 | 86 | 7.2 |
| 1899 | —3 | —40 | —14 | 12 | 18 | 29 | 40 | 32 | 26 | 8 | 9 | —21 | 96 | 8.0 |
| 1900 | —7 | —19 | 0 | —10 | 24 | 34 | 34 | 36 | 27 | 11 | 5 | —27 | 108 | 9.0 |
| 1901 | —19 | —21 | —2 | 0 | 29 | 32 | 37 | 41 | 21 | 22 | 11 | —23 | 128 | 10.6 |
| 1902 | —18 | —5 | 3 | 8 | 20 | 28 | 33 | 36 | 17 | 19 | 6 | —8 | 139 | 11.6 |
| 1903 | —3 | —26 | —12 | 1 | 17 | 31 | 36 | 35 | 14 | 16 | —6 | —4 | 99 | 8.2 |
| 1904 | —16 | —3 | —6 | 13 | 20 | 29 | 32 | 27 | 28 | 7 | 5 | —11 | 125 | 10.4 |
| 1905 | —24 | —42 | 4 | 0 | 20 | 34 | 33 | 40 | 31 | —9 | 5 | —6 | 86 | 7.2 |
| 1906 | —11 | —4 | —21 | 10 | 19 | 26 | 37 | 35 | 30 | 4 | —11 | 7 | 121 | 10.0 |
| 1907 | —6 | 1 | 2 | 8 | 7 | 31 | 41 | 34 | 24 | 20 | —7 | —9 | 146 | 12.2 |
| 1908 | —16 | —22 | —1 | 5 | 17 | 32 | 33 | 28 | 14 | 11 | —24 | —16 | 61 | 5.0 |
| 1909 | —16 | —11 | —4 | 4 | 12 | 35 | 42 | 39 | 23 | 15 | 2 | —23 | 118 | 9.8 |
| 1910 | —13 | —14 | 8 | 11 | 19 | 30 | 39 | 20 | 25 | 11 | 5 | 0 | 141 | 11.7 |
| Sums | —289 | —303 | —113 | 116 | 402 | 608 | 739 | 679 | 461 | 225 | —63 | —259 | 2203 | 183.2 |
| Means | —14.5 | —15.1 | —5.6 | 5.8 | 20.1 | 30.4 | 36.9 | 33.9 | 23.0 | 11.2 | —3.1 | —12.9 | 110.1 | 9.2 |

TABLE VI.—MEAN MINIMUM TEMPERATURES AT LARAMIE FOR 20 YEARS.

| YEARS | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Sums | Means |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1891 | 9.5 | 18.2 | 15.2 | 27.3 | 39.2 | 42.7 | 47.9 | 47.6 | 41.8 | 28.1 | 16.0 | 9.9 | 343.4 | 28.6 |
| 1892 | 10.0 | 15.4 | 21.1 | 25.0 | 33.2 | 41.8 | 49.4 | 45.7 | 38.6 | 25.7 | 24.1 | 11.4 | 341.4 | 28.4 |
| 1893 | 15.7 | 10.1 | 18.5 | 23.3 | 21.3 | 40.8 | 48.6 | 46.7 | 36.2 | 30.1 | 17.9 | 18.2 | 337.4 | 28.1 |
| 1894 | 10.0 | 4.7 | 19.5 | 27.5 | 37.1 | 41.4 | 48.6 | 47.2 | 37.5 | 31.1 | 24.1 | 9.6 | 338.3 | 28.2 |
| 1895 | 11.0 | 6.2 | 16.6 | 27.4 | 34.2 | 39.4 | 45.6 | 47.0 | 38.8 | 26.2 | 14.5 | 5.6 | 312.5 | 26.0 |
| 1896 | 14.6 | 9.2 | 14.8 | 24.1 | 33.3 | 44.2 | 48.8 | 47.1 | 38.8 | 27.2 | 15.8 | 18.9 | 336.8 | 28.1 |
| 1897 | 3.0 | 8.5 | 14.0 | 23.0 | 37.0 | 41.0 | 44.0 | 49.0 | 42.0 | 28.0 | 25.0 | 3.3 | 317.8 | 26.5 |
| 1898 | 6.0 | 14.0 | 10.4 | 26.0 | 33.0 | 41.0 | 51.2 | 47.3 | 35.0 | 26.0 | 12.0 | 2.3 | 304.2 | 25.3 |
| 1899 | 10.4 | —0.5 | 15.5 | 27.6 | 33.7 | 41.6 | 47.7 | 45.9 | 38.3 | 27.6 | 22.1 | 7.1 | 317.0 | 26.4 |
| 1900 | 13.0 | 8.5 | 19.0 | 25.0 | 37.0 | 45.1 | 47.1 | 45.8 | 37.7 | 30.8 | 29.9 | 14.0 | 352.9 | 29.4 |
| 1901 | 10.0 | 6.3 | 16.0 | 23.0 | 36.0 | 40.3 | 52.4 | 49.5 | 36.4 | 30.2 | 23.8 | 11.5 | 335.4 | 27.9 |
| 1902 | 9.9 | 19.3 | 17.5 | 25.1 | 34.9 | 42.4 | 44.6 | 37.0 | 36.1 | 31.7 | 21.5 | 14.8 | 334.8 | 27.9 |
| 1903 | 12.6 | 1.4 | 17.9 | 26.3 | 31.3 | 41.4 | 48.0 | 48.3 | 38.0 | 29.5 | 22.8 | 15.0 | 332.5 | 27.7 |
| 1904 | 9.7 | 19.0 | 20.7 | 25.6 | 34.6 | 40.4 | 46.0 | 46.2 | 38.6 | 27.4 | 19.2 | 15.0 | 342.4 | 28.5 |
| 1905 | 12.5 | 2.3 | 24.0 | 24.1 | 33.2 | 42.9 | 46.0 | 46.8 | 38.4 | 24.3 | 19.4 | 10.0 | 323.9 | 26.9 |
| 1906 | 12.0 | 15.0 | 14.0 | 28.0 | 34.0 | 41.0 | 46.0 | 46.0 | 40.0 | 27.0 | 17.0 | 20.0 | 340.0 | 28.3 |
| 1907 | 13.0 | 21.0 | 25.0 | 24.0 | 31.0 | 39.0 | 48.0 | 47.0 | 38.0 | 28.0 | 15.0 | 11.0 | 340.0 | 28.3 |
| 1908 | 8.1 | 9.6 | 20.1 | 26.3 | 31.7 | 40.3 | 49.9 | 47.0 | 38.3 | 26.7 | 11.4 | 11.3 | 320.7 | 26.7 |
| 1909 | 16.6 | 11.2 | 17.1 | 20.5 | 30.2 | 42.8 | 49.0 | 49.0 | 39.0 | 29.0 | 24.0 | 1.4 | 329.8 | 27.5 |
| 1910 | 13.7 | 10.0 | 24.3 | 24.0 | 34.0 | 44.5 | 49.1 | 46.0 | 40.0 | 31.0 | 28.0 | 15.0 | 359.6 | 29.9 |
| Sums | 221.3 | 209.4 | 361.2 | 503.1 | 679.9 | 834.0 | 957.9 | 932.1 | 767.5 | 565.6 | 403.5 | 225.3 | 6660.8 | 554.6 |
| Means | 11.1 | 10.5 | 18.1 | 25.2 | 34.0 | 41.7 | 47.9 | 46.6 | 38.4 | 28.3 | 20.2 | 11.3 | 333.3 | 27.7 |

TABLE VII.—AVERAGE RELATIVE HUMIDITY AT LARAMIE FOR 20 YEARS.

| YEARS | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Sums | Means |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1891 | ........ | ........ | ........ | ........ | ........ | ........ | 65.3 | 60.4 | 65.7 | 58.9 | 64.6 | 83.2 | 398.1 | 66.4 |
| 1892 | 79.8 | 79.7 | 83.9 | 72.2 | 58.8 | 53.2 | 55.3 | 46.3 | 40.5 | 67.8 | 56.0 | 71.0 | 764.5 | 63.7 |
| 1893 | 56.0 | 70.8 | 67.7 | 62.3 | 51.7 | 38.3 | 43.9 | 50.8 | 43.2 | 57.2 | 66.6 | 70.9 | 682.4 | 56.9 |
| 1894 | 72.4 | 66.1 | 64.5 | 61.3 | 49.7 | 43.4 | 51.5 | 53.8 | 52.3 | 48.4 | 47.8 | 65.8 | 677 | 56.4 |
| 1895 | 62.8 | 68 | 59.4 | 57.2 | 55.5 | 55.1 | 56.9 | 55.7 | 50.4 | 60.2 | 61.1 | 59.6 | 701.9 | 58.5 |
| 1896 | 55.0 | 68.7 | 69.0 | 57.8 | 45.1 | 52.1 | 61.3 | 55.4 | 68.8 | 56.8 | 54.0 | 51.1 | 695.1 | 57.9 |
| 1897 | 62.2 | 70 | 64.9 | 68.3 | 58.6 | 57.9 | 52.9 | 61.4 | 62.4 | 66.2 | 57.6 | 68.7 | 751.1 | 62.6 |
| 1898 | 68.1 | 62.3 | 64.3 | 62.2 | 68.3 | 51.5 | 48.9 | 61.0 | 43.1 | 56.4 | 69.3 | 72.2 | 727.6 | 60.6 |
| 1899 | 70.3 | 63.3 | 73.5 | 55.4 | 48.9 | 46 | 54.7 | 46.1 | 48 | 61.8 | 56.4 | 63.5 | 687.9 | 57.3 |
| 1900 | 59.9 | 67.8 | 62.5 | 78.3 | 58.7 | 56.8 | 61.6 | 58.3 | 69.8 | 58.9 | 56.9 | 58.7 | 748.2 | 62.4 |
| 1901 | 59.9 | 76.3 | 67.6 | 78.0 | 79.7 | 66.7 | 46.1 | 62.0 | 52.3 | 62.2 | 57.6 | 71.9 | 780.3 | 65.0 |
| 1902 | 69.5 | 70.7 | 73.6 | 56.8 | 56.6 | 46.0 | 53.8 | 51.3 | 51.1 | 60.2 | 62.1 | 72.2 | 723.9 | 60.3 |
| 1903 | 69.8 | 72.2 | 68.4 | 62.7 | 65.2 | 65.6 | 54.1 | 48.8 | 59.5 | 56.4 | 63.3 | 65.9 | 751.9 | 60.7 |
| 1904 | 70.3 | 61.2 | 64.9 | 65.5 | 63.9 | 63.9 | 61.1 | 62.7 | 61.1 | 68.6 | 49.9 | 70.5 | 763.6 | 63.6 |
| 1905 | * | * | * | * | * | * | 52.9 | 46.5 | 50.1 | 65.2 | 65.6 | 70.3 | 350.6 | 58.4 |
| 1906 | 72 | 70 | 83 | 73 | 63 | 56 | 59 | 60 | 65 | 66 | 76 | 71 | 814 | 67.8 |
| 1907 | 72 | 68 | 65 | 66 | 75 | 60 | 57 | 54 | 55 | 59 | 59 | 69 | 759 | 63.2 |
| 1908 | 66.0 | 67.0 | 47.6 | 53.9 | 63.6 | 57.7 | 61.0 | 63.6 | 49.6 | 62.3 | 64.8 | 66.3 | 723.4 | 60.3 |
| 1909 | 67.2 | 67.2 | 70.1 | 75.8 | 69.3 | 62.1 | 54.8 | 63.9 | 62.3 | 53.8 | 66.1 | 75.2 | 787.8 | 65.6 |
| 1910 | 68.3 | 68.2 | 55.7 | 57.6 | 64.1 | 48.8 | 52.5 | 49.9 | 55.0 | 55.0 | 63.3 | 74.3 | 712.7 | 59.4 |
| Sums | 1201.5 | 1237.5 | 1205.6 | 1164.3 | 1098.7 | 981.1 | 1104.6 | 1111.9 | 1105.2 | 1201.3 | 1218.0 | 1371.3 | 14001.0 | |
| Means | 66.7 | 69.6 | 66.9 | 64.7 | 61.1 | 54.5 | 55.2 | 55.6 | 55.3 | 60.1 | 60.9 | 68.6 | | 61.4 |

*No record.

# Summary of Meteorological Data for Different Points in the State

### AFTON, LINCOLN COUNTY.

Summary of Meteorological Data, 6 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 1.33 | 1.59 | 2.08 | 1.76 | 3.22 | 1.34 | 0.79 | 1.54 | 0.81 | 1.37 | 0.77 | 1.43 | 18.03 |
| Highest temp.... | 46 | 55 | 62 | 78 | 83 | 88 | 91 | 94 | 87 | 81 | 67 | 52 | 94 |
| Lowest temp.... | —23 | —41 | —20 | 1 | 17 | 24 | 30 | 16 | 15 | 9 | —16 | —32 | —41 |
| Mean minimum temperature .. | 5.4 | 7.7 | 18.1 | 25.2 | 31.6 | 36.8 | 42.5 | 40.9 | 34.9 | 27.9 | 18.8 | 7.7 | 24.7 |
| Mean maximum temperature .. | 28.2 | 32.9 | 41.7 | 53.7 | 61.2 | 71.8 | 79.5 | 79.0 | 73.1 | 61.8 | 59.8 | 31.2 | 53.8 |
| Mean temp...... | 16.8 | 20.9 | 28.4 | 38.3 | 46.2 | 54.6 | 60.1 | 60.7 | 52.7 | 41.5 | 30.4 | 20.3 | 39.5 |

### ALCOVA-PATHFINDER, NATRONA COUNTY.

Summary of Meteorological Data, 11 Years.*

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.37 | 0.36 | 0.65 | 1.08 | 2.02 | 1.02 | 0.95 | 0.82 | 0.95 | 0.78 | 0.16 | 0.52 | 9.65 |
| Highest temp.... | 56 | 60 | 72 | 88 | 97 | 104 | 107 | 103 | 94 | 83 | 77 | 55 | 107 |
| Lowest temp..... | —25 | —35 | —29 | 1 | 12 | 20 | 32 | 27 | 22 | 9 | —8 | —22 | —35 |
| Mean minimum temperature .. | 14.7 | 15.9 | 23.2 | 30.0 | 36.9 | 46.7 | 53.5 | 51.5 | 43.3 | 32.6 | 23.8 | 15.7 | 32.3 |
| Mean maximum temperature .. | 34.2 | 38.8 | 46.8 | 59.7 | 65.9 | 78.7 | 87.4 | 85.4 | 75.6 | 61.2 | 45.3 | 35.4 | 59.6 |
| Mean temp...... | 26.3 | 25.3 | 33.6 | 44.3 | 53.0 | 62.5 | 70.0 | 69.4 | 59.0 | 46.9 | 36.3 | 26.4 | 46.1 |

*First six years records kept at Alcova, last five at Pathfinder.

### BASIN, BIG HORN COUNTY.

Summary of Meteorological Data, 12 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.31 | 0.44 | 0.39 | 0.61 | 1.18 | 1.12 | 0.36 | 0.22 | 0.41 | 0.34 | 0.13 | 0.29 | 5.8 |
| Highest temp.... | 58 | 68 | 78 | 87 | 93 | 110 | 110 | 110 | 91 | 84 | 69 | 55 | 110 |
| Lowest temp..... | —39 | —51 | —32 | 3 | 20 | 33 | 40 | 37 | 22 | 16 | —12 | —27 | —51 |
| Mean minimum temperature ... | 2.0 | 7.4 | 21.1 | 32.6 | 40.4 | 49.5 | 57.1 | 75.7 | 43.7 | 32.6 | 18.8 | 7.4 | 32.4 |
| Mean maximum temperature ... | 29.6 | 34.6 | 49.7 | 63.9 | 71.2 | 81.9 | 90.9 | 89.0 | 78.7 | 63.7 | 46.3 | 29.9 | 60.8 |
| Mean temp...... | 17.2 | 19.3 | 32.5 | 47.2 | 55.4 | 66.9 | 74.4 | 72.7 | 60.8 | 47.3 | 32.8 | 17.7 | 45.4 |

## BORDER, LINCOLN COUNTY.

Summary of Meteorological Data, 9 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 1.45 | 1.42 | 1.69 | 1.14 | 1.70 | 1.15 | 0.39 | 1.23 | 1.03 | 0.93 | 0.98 | 0.94 | 14.05 |
| Highest temp.... | 46 | 50 | 67 | 78 | 87 | 93 | 94 | 92 | 89 | 84 | 65 | 49 | 94 |
| Lowest temp..... | —32 | —51 | —36 | 0 | 18 | 21 | 27 | 20 | 13 | —1 | —29 | —35 | —51 |
| Mean minimum temperature ... | 0.1 | 0.4 | 13.1 | 24.3 | 31.2 | 37.5 | 42.2 | 39.7 | 31.1 | 22.6 | 14.4 | 1.8 | 21.5 |
| Mean maximum temperature ... | 25.1 | 28.1 | 38.7 | 52.5 | 32.1 | 72.1 | 82.1 | 81.4 | 72.2 | 59.7 | 45.0 | 25.4 | 52.9 |
| Mean temp...... | 12.8 | 14.3 | 24.5 | 37.6 | 46.4 | 54.3 | 61.8 | 60.5 | 51.3 | 40.9 | 29.3 | 13.4 | 37.3 |

## BUFFALO, JOHNSON COUNTY.

Summary of Meteorological Data, 19 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.45 | 0.49 | 0.75 | 1.21 | 2.62 | 2.15 | 1.06 | 0.97 | 0.80 | 0.54 | 0.36 | 0.56 | 11.96 |
| Highest temp.... | 65 | 65 | 75 | 82 | 91 | 102 | 104 | 104 | 95 | 84 | 74 | 64 | 104 |
| Lowest temp..... | —28 | —35 | —27 | 1 | 18 | 28 | 36 | 30 | 20 | —2 | —26 | —24 | —35 |
| Mean temp...... | 23.1 | 23.9 | 31.6 | 43.9 | 51.4 | 60.1 | 64.2 | 68.1 | 58.1 | 46.8 | 36.3 | 27.2 | 44.6 |

## CAMBRIA-NEWCASTLE, WESTON COUNTY.

Summary of Meteorological Data, 6 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.80 | 0.60 | 1.11 | 1.17 | 3.66 | 3.84 | 2.01 | 1.29 | 1.30 | 0.74 | 0.35 | 0.89 | 17.76 |
| Highest temp.... | 60 | 66 | 72 | 84 | 87 | 98 | 101 | 101 | 100 | 83 | 78 | 63 | 101 |
| Lowest temp..... | —24 | —27 | —14 | 5 | 13 | 34 | 38 | 33 | 20 | 10 | —7 | —18 | —27 |
| Mean temp....... | 22.6 | 26.9 | 33.9 | 40.0 | 49.5 | 61.2 | 69.6 | 70.2 | 61.8 | 46.6 | 35.6 | 24.8 | 45.2 |

## CHEYENNE, LARAMIE COUNTY.

Summary of Meteorological Data, 40 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | .38 | 0.54 | 0.98 | 1.73 | 2.48 | 1.65 | 2.06 | 1.47 | 1.00 | 0.71 | 0.41 | 0.39 | 13.80 |
| Highest temp.... | 64 | 64 | 77 | 82 | 88 | 97 | 100 | 96 | 90 | 85 | 75 | 64 | 100 |
| Lowest temp..... | —38 | —30 | —17 | 2 | 8 | 28 | 36 | 25 | 16 | —5 | —20 | —24 | —38 |
| Mean minimum temperature ... | 14.5 | 15.5 | 21.5 | 29.4 | 38.2 | 46.9 | 53.0 | 51.8 | 42.8 | 32.8 | 23.2 | 17.9 | 32.3 |
| Mean maximum temperature ... | 36.9 | 37.9 | 44.4 | 53.5 | 63.4 | 74.8 | 81.3 | 80.2 | 71.8 | 58.7 | 46.8 | 39.6 | 57.4 |
| Mean temp....... | 25.8 | 27 | 32.7 | 41.2 | 50.9 | 61.0 | 67.0 | 65.9 | 57.1 | 45.6 | 34.8 | 28.6 | 44.8 |
| Per cent sunshine | 66 | 64 | 63 | 63 | 57 | 66 | 69 | 68 | 70 | 70 | 66 | 64 | 66 |

### CLARK, PARK COUNTY.

Summary of Meteorological Data, 4 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.70 | 0.44 | 0.92 | 0.88 | 2.74 | 1.84 | 1.46 | 0.99 | 0.87 | 0.47 | 0.44 | 0.33 | 12.08 |
| Highest temp.... | 59 | 61 | 67 | 82 | 85 | 96 | 100 | 100 | 94 | 88 | 68 | 70 | 100 |
| Lowest temp..... | —23 | —18 | —2 | 7 | 27 | 38 | 44 | 39 | 23 | 11 | 1 | —23 | —23 |
| Mean temp...... | 23.7 | 31.2 | 36.5 | 45.2 | 51.8 | 61.0 | 70.2 | 68.6 | 61.3 | 49.6 | 37.5 | 27.1 | 47.00 |

### DANIEL, LINCOLN COUNTY.

Summary of Meteorological Data, 11 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 1.08 | 1.30 | 1.17 | 0.79 | 1.37 | 1.17 | 0.85 | 1.14 | 0.79 | 0.72 | 0.47 | 0.85 | 11.70 |
| Highest temp.... | 60 | 53 | 54 | 70 | 90 | 87 | 92 | 87 | 85 | 77 | 63 | 65 | 92 |
| Lowest temp..... | —44 | —51 | —45 | —13 | 10 | 17 | 20 | 17 | 10 | —5 | —29 | —31 | —51 |
| Mean temp....... | 14.0 | 12.4 | 20.6 | 32.4 | 42.1 | 49.5 | 55.9 | 54.8 | 46.4 | 37.9 | 27.0 | 16.0 | 34.1 |

### EATON'S RANCH, SHERIDAN COUNTY.

Summary of Meteorological Data, 6 years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.95 | 0.49 | 1.97 | 2.38 | 4.79 | 2.68 | 0.98 | 1.41 | 1.49 | 1.04 | 0.66 | 1.55 | 20.39 |
| Highest temp.... | 65 | 76 | 79 | 84 | 83 | 96 | 100 | 98 | 98 | 89 | 78 | 73 | 100 |
| Lowest temp..... | —24 | —26 | —19 | —1 | 20 | 29 | 42 | 32 | 24 | 3 | —11 | —22 | —26 |
| Mean minimum temperature ... | 14.7 | 16.7 | 25.9 | 33.9 | 38.4 | 47.8 | 57.0 | 55.2 | 48.1 | 35.7 | 28.9 | 20.5 | 35.2 |
| Mean maximum temperature ... | 39.9 | 44.2 | 48.8 | 57.6 | 62.5 | 72.3 | 82.6 | 81.0 | 73.2 | 61.0 | 50.8 | 42.5 | 59.7 |
| Mean temp...... | 27.1 | 30.9 | 34.9 | 41.7 | 49.6 | 59.0 | 68.6 | 68.3 | 61.3 | 47.3 | 40.2 | 31.0 | 46.7 |

### EVANSTON, UINTA COUNTY.

Summary of Meteorological Data, 15 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 1.17 | 1.25 | 1.74 | 1.36 | 2.[illegible]2 | 0.90 | 0.75 | 1.08 | 0.90 | 1.27 | 0.98 | 0.90 | 14.32 |
| Highest temp.... | 51 | 51 | 65 | 75 | 8 | 89 | 93 | 90 | 86 | 79 | 66 | 57 | 93 |
| Lowest temp..... | —21 | —38 | —22 | 4 | 1 | 20 | 28 | 24 | 18 | —3 | —17 | —23 | —38 |
| Mean minimum temperature ... | 8.7 | 10.9 | 17.7 | 26.0 | 31.3 | 37.3 | 43.5 | 43.3 | 35.0 | 26.4 | 18.8 | 9.8 | 25.8 |
| Mean maximum temperature ... | 31.8 | 33.5 | 40.7 | 51.8 | 60.0 | 69.8 | 72.3 | 78.3 | 69.6 | 57.7 | 47.5 | 33.5 | 53.9 |
| Mean temp...... | 20.7 | 21.1 | 28.3 | 38.8 | 45.5 | 53.9 | 61.4 | 60.8 | 52.3 | 41.2 | 31.8 | 20.1 | 39.7 |

### FORT LARAMIE, GOSHEN COUNTY.

Summary of Meteorological Data, 16 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.45 | 0.41 | 0.69 | 1.56 | 2.47 | 1.72 | 1.45 | 0.96 | 0.94 | 0.69 | 0.36 | 0.46 | 12.16 |
| Highest temp.... | 65 | 69 | 80 | 92 | 93 | 102 | 106 | 103 | 104 | 91 | 79 | 75 | 106 |
| Lowest temp..... | —30 | —48 | —24 | 10 | 16 | 28 | 37 | 29 | 13 | 8 | —14 | -41 | —48 |
| Mean minimum temperature ... | 11.1 | 9.7 | 22.6 | 30.1 | 39.2 | 49.4 | 55.2 | 53.6 | 42.6 | 30.2 | 20.0 | 13.2 | 31.4 |
| Mean maximum temperature ... | 40.7 | 40.8 | 51.4 | 61.4 | 68.7 | 78.0 | 88.0 | 89.3 | 79.1 | 66.0 | 53.1 | 41.3 | 63.2 |
| Mean temp....... | 25.1 | 27.2 | 34.7 | 44.9 | 55.5 | 65.4 | 73.0 | 71.6 | 60.0 | 45.3 | 34.7 | 27.5 | 47.1 |

### FORT WASHAKIE, FREMONT COUNTY.

Summary of Meteorological Data, 14 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.51 | 0.37 | 1.35 | 2.02 | 2.44 | 1.26 | 0.84 | 0.70 | 0.66 | 1.07 | 0.52 | 0.49 | 12.23 |
| Highest temp.... | 60 | 68 | 72 | 82 | 90 | 95 | 97 | 99 | 91 | 81 | 70 | 68 | 99 |
| Lowest temp..... | —33 | —35 | —27 | 8 | 14 | 20 | 33 | 31 | 5 | —2 | —30 | —34 | —35 |
| Mean temp....... | 19.5 | 22.5 | 32.2 | 42.8 | 53.0 | 60.9 | 67.8 | 67.0 | 56.2 | 44.1 | 29.8 | 23.4 | 43.2 |

### FOUR BEAR, PARK COUNTY.

Summary of Meteorological Data, 10 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.25 | 0.40 | 0.94 | 1.33 | 1.85 | 1.75 | 1.05 | 0.97 | 1.16 | 0.76 | 0.50 | 0.25 | 11.21 |
| Highest temp.... | 62 | 62 | 66 | 73 | 78 | 86 | 92 | 88 | 85 | 76 | 68 | 60 | 92 |
| Lowest temp..... | —32 | —40 | —26 | —2 | 6 | 22 | 28 | 20 | 8 | —1 | —28 | —23 | —40 |
| Mean temp....... | 23.2 | 21.1 | 26.0 | 37.8 | 46.3 | 53.6 | 59.4 | 59.8 | 50.1 | 41.9 | 31.4 | 26.1 | 39.7 |

### GREEN RIVER, SWEETWATER COUNTY.

Summary of Meteorological Data, 6 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.56 | 0.74 | 0.78 | 0.59 | 1.09 | 0.32 | 0.16 | 0.60 | 0.80 | 0.59 | 0.63 | 0.44 | 7.30 |
| Highest temp.... | 53 | 55 | 75 | 82 | 90 | 95 | 98 | 98 | 90 | 89 | 62 | 51 | 98 |
| Lowest temp..... | —21 | —31 | —21 | 8 | 16 | 29 | 37 | 23 | 18 | 6 | —11 | —32 | —32 |
| Mean minimum temperature ... | 6.2 | 8.3 | 20.3 | 27.7 | 33.2 | 41.6 | 49.3 | 47.0 | 37.3 | 26.5 | 16.1 | 6.7 | 26.7 |
| Mean maximum temperature ... | 31.6 | 33.6 | 47.2 | 59.3 | 64.5 | 76.9 | 86.6 | 84.6 | 75.1 | 61.6 | 47.0 | 32.0 | 58.3 |
| Mean temp....... | 19.7 | 21.6 | 31.9 | 43.4 | 48.9 | 58.0 | 67.3 | 65.5 | 55.9 | 43.9 | 31.0 | 18.8 | 42.2 |

## GRIGGS, JOHNSON COUNTY.

Summary of Meteorological Data, 8 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.43 | 0.62 | 0.90 | 1.53 | 3.45 | 2.05 | 1.35 | 0.85 | 1.06 | 0.78 | 0.47 | 0.84 | 14.33 |
| Highest temp.... | 60 | 68 | 73 | 82 | 91 | 95 | 103 | 99 | 96 | 83 | 73 | 66 | 103 |
| Lowest temp..... | —41 | —51 | —28 | 4 | 16 | 28 | 35 | 31 | 22 | —3 | —26 | —33 | —57 |
| Mean temp....... | 24.4 | 24 | 33.2 | 42.9 | 51.8 | 58.9 | 66.5 | 66.7 | 55.9 | 47.1 | 35.8 | 27.8 | 44.6 |

## HUNTER'S STATION, JOHNSON COUNTY.

Summary of Meteorological Data, 5 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.63 | 0.76 | 1.93 | 1.73 | 5.77 | 3.44 | 2.17 | 2.04 | 1.26 | 1.28 | 0.87 | 1.60 | 23.48 |
| Highest temp.... | 55 | 59 | 63 | 71 | 73 | 83 | 86 | 86 | 82 | 76 | 63 | 58 | 86 |
| Lowest temp..... | —20 | —25 | —28 | —6 | 4 | 22 | 28 | 14 | 4 | —10 | —14 | —21 | —28 |
| Mean minimum temperature ... | 7.2 | 5.3 | 15.1 | 21.7 | 27.7 | 37.1 | 42.3 | 40.7 | 34.1 | 25.6 | 17.3 | 6.4 | 23.4 |
| Mean maximum temperature ... | 35.2 | 33.0 | 42.1 | 48.3 | 52.2 | 64.2 | 72.0 | 72.0 | 62.6 | 53.0 | 43.6 | 31.1 | 50.8 |
| Mean temp....... | 19.7 | 23.3 | 23.2 | 32.0 | 39.4 | 48.7 | 55.9 | 56.4 | 49.4 | 38.9 | 28.7 | 20.0 | 36.3 |

## HYATTVILLE, BIG HORN COUNTY.

Summary of Meteorological Data, 12 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Highest temp.... | 60 | 70 | 79 | 89 | 95 | 102 | 104 | 105 | 98 | 94 | 71 | 62 | 105 |
| Lowest temp..... | —32 | —31 | —23 | —7 | 21 | 32 | 34 | 23 | 20 | 4 | —14 | —21 | —32 |
| Mean minimum temperature ... | 9.6 | 11.5 | 22.0 | 30.8 | 38.4 | 45.3 | 51.4 | 50.6 | 42.1 | 33.0 | 22.4 | 12.9 | 30.8 |
| Mean maximum temperature ... | 37.0 | 39.4 | 49.8 | 61.8 | 69.8 | 80.3 | 88.5 | 86.9 | 76.6 | 64.3 | 51.4 | 39.0 | 62.1 |
| Mean temp....... | 24.4 | 25.7 | 31.9 | 45.8 | 54.7 | 62.9 | 69.7 | 68.6 | 59.1 | 47.4 | 36.5 | 25.9 | 46.3 |

## JACKSON, LINCOLN COUNTY.

Summary of Meteorological Data, 3 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 2.56 | 1.82 | 1.81 | 0.91 | 2.84 | 1.43 | 1.07 | 1.62 | 0.96 | 0.42 | 0.56 | 1.14 | 17.17 |

### LANDER, FREMONT COUNTY.

Summary of Meteorological Data, 19 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.40 | 0.65 | 1.68 | 2.30 | 2.46 | 1.13 | 0.77 | 0.68 | 0.89 | 1.24 | 0.64 | 0.84 | 13.68 |
| Highest temp.... | 59 | 64 | 71 | 82 | 86 | 95 | 99 | 96 | 90 | 82 | 72 | 61 | 99 |
| Lowest temp..... | —36 | —35 | —24 | 2 | 13 | 26 | 28 | 23 | 7 | 2 | —31 | —30 | —36 |
| Mean minimum temperature ... | 6.1 | 7.9 | 19.4 | 29.4 | 37.2 | 44.2 | 49.8 | 48.2 | 39.3 | 29.3 | 18.9 | 6.9 | 28.0 |
| Mean maximum temperature ... | 33.7 | 35.6 | 46.9 | 56.6 | 63.8 | 75.1 | 83.0 | 82.4 | 72.4 | 59.4 | 47.3 | 33.5 | 57.5 |
| Mean temp...... | 20.3 | 22.2 | 28.1 | 41.2 | 50.6 | 58.8 | 66.1 | 65.3 | 55.8 | 44.1 | 32.1 | 20.0 | 42 |
| Per cent sunshine | 67 | 76 | 71 | 74 | 63 | 71 | 78 | 77 | 73 | 66 | 64 | 68 | 71 |

### LEO, CARBON COUNTY.

Summary of Meteorological Data, 10 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.60 | 0.58 | 0.90 | 0.93 | 2.03 | 1.03 | 0.55 | 0.50 | 0.97 | 0.68 | 0.34 | 0.67 | 9.78 |
| Highest temp.... | 51 | 59 | 68 | 77 | 84 | 87 | 94 | 92 | 85 | 82 | 64 | 55 | 94 |
| Lowest temp..... | —36 | —42 | —26 | —1 | 12 | 24 | 28 | 14 | 12 | 2 | —18 | —26 | —42 |
| Mean minimum temperature ... | 12.0 | 11.6 | 20.2 | 26.0 | 33.4 | 40.4 | 46.5 | 47.0 | 37.4 | 28.3 | 20.6 | 13.1 | 28.0 |
| Mean maximum temperature ... | 31.2 | 32.2 | 41.5 | 52.5 | 60.4 | 71.3 | 78.8 | 79.4 | 68.9 | 56.4 | 45.1 | 33.0 | 54.2 |
| Mean temp....... | 21.9 | 22.4 | 28.7 | 38.8 | 46.4 | 55.2 | 62.7 | 63.2 | 53.0 | 42.1 | 32.5 | 22.5 | 40.8 |

### LOLABAMA RANCH, PARK COUNTY.

Summary of Meteorological Data, 9 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.66 | 0.34 | 1.47 | 1.40 | 2.78 | 1.54 | 1.45 | 1.53 | 0.82 | 0.68 | 0.61 | 0.25 | 13.53 |
| Highest temp.... | 48 | 54 | 64 | 74 | 77 | 85 | 88 | 88 | 80 | 77 | 62 | 53 | 88 |
| Lowest temp..... | —25 | —41 | —30 | —5 | 12 | 21 | 26 | 16 | 13 | —4 | —23 | —24 | —41 |
| Mean minimum temperature ... | 9.0 | 9.1 | 15.6 | 23.5 | 30.7 | 35.8 | 38.6 | 38.3 | 34.0 | 25.4 | 17.0 | 12.8 | 24.2 |
| Mean maximum temperature ... | 29.4 | 32.5 | 41.7 | 50.8 | 55.2 | 66.9 | 74.6 | 74.7 | 64.3 | 55.6 | 40.8 | 32.8 | 51.7 |
| Mean temp....... | 20.1 | 21.2 | 27.9 | 35.0 | 41.2 | 50.8 | 55.9 | 56.4 | 49.3 | 40.3 | 29.8 | 22.5 | 37.5 |

### LOVELL, BIG HORN COUNTY.

Summary of Meteorological Data. 6 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.57 | 0.28 | 0.27 | 0.50 | 1.57 | 0.87 | 0.60 | 0.30 | 0.30 | 0.54 | 0.21 | 0.13 | 6.14 |
| Highest temp.... | 59 | 62 | 78 | 86 | 97 | 105 | 106 | 101 | 94 | 82 | 69 | 54 | 106 |
| Lowest temp..... | —37 | —51 | —17 | 8 | 22 | 31 | 33 | 28 | 17 | 11 | —20 | —24 | —51 |
| Mean temp....... | 16.6 | 24.1 | 28.8 | 45.2 | 55.4 | 64.2 | 69.0 | 67.9 | 57.9 | 45.0 | 30.6 | 16.3 | 43.4 |

### LUSK, NIOBRARA COUNTY.

Summary of Meteorological Data, 10 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.51 | 0.54 | 1.19 | 1.37 | 2.83 | 2.66 | 1.49 | 1.15 | 0.72 | 0.63 | 0.31 | 0.63 | 14.03 |
| Highest temp.... | 60 | 65 | 85 | 87 | 92 | 100 | 105 | 100 | 96 | 90 | 79 | 67 | 105 |
| Lowest temp..... | —33 | —35 | —24 | 4 | 14 | 27 | 30 | 25 | 12 | 5 | —16 | —32 | —35 |
| Mean minimum temperature ... | 9.9 | 9.4 | 20.5 | 27.2 | 36.4 | 45.0 | 50.4 | 49.0 | 39.2 | 28.5 | 20.0 | 11.1 | 28.9 |
| Mean maximum temperature ... | 36.7 | 38.8 | 46.6 | 57.0 | 66.0 | 74.7 | 83.4 | 82.4 | 73.1 | 62.5 | 48.9 | 36.7 | 58.9 |
| Mean temp....... | 22.7 | 22.7 | 30.9 | 41.7 | 51.6 | 61.3 | 68.2 | 67.0 | 53.7 | 44.6 | 32.7 | 25.7 | 43.8 |

### MOORCROFT, CROOK COUNTY.

Summary of Meteorological Data, 7 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.47 | 0.70 | 1.08 | 1.31 | 2.44 | 2.40 | 1.53 | 1.71 | 1.24 | 0.50 | 0.48 | 1.03 | 14.89 |
| Highest temp.... | 58 | 65 | 74 | 86 | 88 | 95 | 104 | 104 | 96 | 92 | 76 | 63 | 104 |
| Lowest temp..... | —26 | —40 | —21 | —10 | 10 | 31 | 40 | 34 | 24 | —6 | —22 | —30 | —40 |
| Mean temp....... | 19.8 | 22.8 | 32.3 | 43.6 | 50.2 | 62.1 | 68.7 | 69.1 | 58.6 | 47.9 | 35.9 | 22.3 | 44.4 |

### PINE BLUFFS, LARAMIE COUNTY.

Summary of Meteorological Data, 9 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.16 | 0.62 | 1.16 | 2.51 | 2.51 | 1.88 | 2.58 | 1.48 | 1.00 | 0.73 | 0.31 | 0.45 | 15.39 |
| Highest temp.... | 69 | 73 | 86 | 82 | 94 | 101 | 101 | 99 | 100 | 89 | 82 | 70 | 101 |
| Lowest temp..... | —26 | —33 | —14 | 5 | 7 | 28 | 33 | 38 | 13 | 5 | —15 | —33 | —33 |
| Mean temp....... | 28.2 | 27.4 | 35.9 | 44.0 | 52.6 | 62.0 | 68.4 | 69.1 | 60.2 | 48.2 | 37.8 | 30.1 | 50.9 |

### PINEDALE, FREMONT COUNTY.

Summary of Meteorological Data, 5 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 1.24 | 0.74 | 1.13 | 0.58 | 1.36 | 1.32 | 0.97 | 2.06 | 0.61 | 0.39 | 0.41 | 0.74 | 11.55 |
| Highest temp.... | 43 | 47 | 59 | 75 | 79 | 88 | 94 | 89 | 84 | 74 | 58 | 48 | 94 |
| Lowest temp..... | —34 | —38 | —38 | —11 | 9 | 21 | 30 | 15 | 16 | 3 | —9 | —27 | —37 |
| Mean minimum temperature ... | 1.1 | 0.6 | 8.7 | 19.9 | 27.4 | 33.3 | 40.2 | 35.9 | 30.9 | 22.3 | 13.0 | 0.7 | 19.5 |
| Mean maximum temperature ... | 25.9 | 29.4 | 37.9 | 50.0 | 60.0 | 69.9 | 80.6 | 74.4 | 68.5 | 55.7 | 41.1 | 28.1 | 51.8 |
| Mean temp....... | 12.6 | 15.3 | 21.6 | 33.5 | 32.9 | 50.0 | 59.8 | 55.0 | 49.4 | 38.8 | 26.3 | 14.6 | 34.2 |

## RAWLINS, CARBON COUNTY.

Summary of Meteorological Data, 9 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.58 | 0.77 | 1.23 | 1.11 | 1.80 | 1.13 | 1.12 | 0.56 | 0.93 | 0.75 | 0.59 | 0.90 | 11.47 |
| Highest temp.... | 52 | 58 | 67 | 78 | 89 | 93 | 102 | 99 | 90 | 80 | 68 | 54 | 102 |
| Lowest temp..... | —20 | —30 | —19 | 9 | 13 | 23 | 33 | 27 | 18 | 11 | 0 | —24 | —30 |
| Mean minimum temperature ... | 12.0 | 15.0 | 21.4 | 29.2 | 35.9 | 42.8 | 48.8 | 47.4 | 38.5 | 31.0 | 21.7 | 16.1 | 30.0 |
| Mean maximum temperature ... | 33.4 | 35.2 | 42.4 | 56.0 | 63.6 | 77.1 | 85.9 | 83.1 | 70.1 | 60.0 | 46.5 | 35.6 | 57.4 |
| Mean temp....... | 22.8 | 23.6 | 30.1 | 42.0 | 50.1 | 59.5 | 66.3 | 64.6 | 54.0 | 44.2 | 33.3 | 23.7 | 42.8 |

## SARATOGA, CARBON COUNTY.

Summary of Meteorological Data, 11 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.81 | 1.04 | 1.80 | 1.29 | 1.92 | 0.72 | 1.01 | 1.05 | 0.89 | 1.05 | 0.76 | 1.36 | 13.70 |
| Highest temp.... | 69 | 54 | 71 | 79 | 89 | 95 | 97 | 95 | 86 | 85 | 69 | 56 | 97 |
| Lowest temp..... | —28 | —35 | —22 | 6 | 10 | 30 | 34 | 20 | 20 | 6 | —16 | —30 | —35 |
| Mean minimum temperature ... | 11.1 | 13.9 | 19.5 | 27.7 | 34.2 | 41.3 | 47.3 | 46.5 | 38.6 | 29.0 | 21.0 | 11.6 | 28.5 |
| Mean maximum temperature ... | 35.8 | 37.4 | 45.2 | 56.8 | 65.2 | 75.2 | 82.9 | 81.2 | 71.6 | 61.0 | 48.6 | 33.2 | 59.8 |
| Mean temp....... | 21 | 22.4 | 30.3 | 40.4 | 50.1 | 58.5 | 65.8 | 63.2 | 54.1 | 43.5 | 31.5 | 22.6 | 42.0 |

## SHERIDAN, SHERIDAN COUNTY.

Summary of Meteorological Data, 14 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.83 | 0.78 | 1.46 | 1.64 | 3.01 | 2.00 | 0.78 | 0.76 | 1.12 | 0.79 | 0.68 | 0.67 | 14.52 |
| Highest temp.... | 60 | 65 | 76 | 85 | 91 | 98 | 105 | 100 | 97 | 87 | 76 | 67 | 105 |
| Lowest temp..... | —36 | —45 | —26 | —3 | 15 | 32 | 36 | 33 | 7 | 2 | —18 | —33 | —45 |
| Mean temp....... | 19.4 | 21.3 | 30.2 | 42.9 | 50.8 | 60.0 | 67.3 | 66.3 | 56.8 | 44.8 | 32.3 | 24.2 | 43.0 |
| Per cent sunshine | 66 | 65 | 62 | 69 | 62 | 68 | 81 | 74 | 70 | 60 | 56 | 60 | 66 |

## SHOSHONE DAM, PARK COUNTY.

Summary of Meteorological Data, 5 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Highest temp.... | 56 | 63 | 74 | 84 | 82 | 95 | 100 | 99 | 92 | 89 | 74 | 59 | 100 |
| Lowest temp..... | —29 | —22 | —16 | 4 | 23 | 28 | 37 | 33 | 24 | 14 | —2 | —16 | —29 |
| Mean minimum temperature ... | 14.9 | 18.4 | 24.8 | 32.5 | 38.3 | 47.1 | 55.4 | 53.9 | 47.4 | 37.9 | 27.5 | 20.1 | 34.8 |
| Mean maximum temperature ... | 34.7 | 42.5 | 47.1 | 58.1 | 61.7 | 72.0 | 82.5 | 80.8 | 73.3 | 62.7 | 47.5 | 37.3 | 58.4 |
| Mean temp....... | 24.1 | 32.8 | 32.7 | 43.2 | 49.0 | 58.2 | 67.7 | 67.6 | 60.0 | 49.5 | 37.4 | 27.5 | 45.8 |

### SOUTH PASS CITY, FREMONT COUNTY.

Summary of Meteorological Data, 9 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 2.07 | 2.41 | 2.62 | 2.62 | 2.05 | 0.76 | 0.90 | 0.58 | 0.90 | 0.88 | 0.94 | 0.87 | 17.60 |
| Highest temp.... | 60 | 49 | 68 | 69 | 83 | 91 | 95 | 102 | 86 | 74 | 64 | 51 | 102 |
| Lowest temp..... | —31 | —40 | —33 | —3 | 8 | 17 | 18 | 9 | 10 | —9 | —18 | —30 | —40 |
| Mean minimum temperature ... | 1.6 | 0.8 | 10.7 | 20.4 | 28.6 | 34.4 | 38.7 | 38.1 | 28.8 | 21.6 | 12.0 | 1.0 | 19.8 |
| Mean maximum temperature ... | 26.8 | 28.6 | 35.9 | 47.1 | 57.6 | 67.6 | 75.3 | 76.9 | 65.8 | 54.6 | 40.5 | 27.5 | 50.3 |

### SUNDANCE, CROOK COUNTY.

Summary of Meteorological Data, 9 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 1.27 | 1.22 | 2.14 | 2.12 | 2.86 | 3.29 | 1.63 | 1.24 | 1.02 | 1.18 | 1.17 | 1.13 | 20.27 |
| Highest temp.... | 60 | 57 | 68 | 75 | 88 | 96 | 96 | 98 | 95 | 83 | 60 | 52 | 98 |
| Lowest temp..... | —28 | —39 | —23 | 8 | 19 | 32 | 37 | 33 | 21 | 12 | —15 | —21 | —39 |
| Mean temp....... | 17.4 | 18.2 | 24.2 | 40.3 | 50.0 | 59.5 | 67.0 | 66.2 | 57.5 | 44.1 | 28.4 | 24.4 | 41.4 |

### THERMOPOLIS, HOT SPRINGS COUNTY.

Summary of Meteorological Data, 8 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.14 | 0.54 | 0.66 | 2.14 | 2.84 | 1.37 | 0.26 | 0.53 | 1.01 | 0.90 | 0.21 | 0.69 | 11.29 |
| Highest temp.... | 60 | 65 | 78 | 89 | 95 | 103 | 106 | 104 | 98 | 87 | 74 | 63 | 106 |
| Lowest temp..... | —38 | —32 | —9 | 2 | 16 | 33 | 39 | 23 | 24 | 16 | —10 | —30 | —38 |
| Mean minimum temperature ... | 5.4 | 6.4 | 19.4 | 30.3 | 38.8 | 46.6 | 53.0 | 50.6 | 41.1 | 31.1 | 18.3 | 7.1 | 29.0 |
| Mean maximum temperature ... | 33.8 | 35.6 | 47.7 | 59.8 | 69.8 | 80.9 | 90.9 | 89.5 | 77.8 | 65.5 | 48.8 | 35.4 | 61.3 |
| Mean temp....... | 23.3 | 23.7 | 35.8 | 45.5 | 55.9 | 63.8 | 71.9 | 70.5 | 59.7 | 47.3 | 34.8 | 19.9 | 46.0 |

## YELLOWSTONE PARK.

Summary of Meteorological Data, 23 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 2.24 | 1.84 | 2.18 | 1.38 | 1.91 | 1.64 | 1.18 | 1.02 | 1.01 | 1.14 | 1.44 | 1.82 | 18.80 |
| Highest temp.... | 44 | 50 | 62 | 74 | 78 | 86 | 88 | 87 | 83 | 75 | 60 | 48 | 88 |
| Lowest temp..... | —20 | —36 | —24 | 2 | 18 | 27 | 31 | 20 | 12 | —3 | —9 | —16 | —36 |
| Mean minimum temperature ... | 11.2 | 10.8 | 18.1 | 25.3 | 33.8 | 39.3 | 45.4 | 44.6 | 37.4 | 30.2 | 21.7 | 13.6 | 27.6 |
| Mean maximum temperature ... | 27.7 | 30.9 | 37.7 | 48.8 | 57.0 | 65.2 | 76.2 | 75.0 | 64.9 | 53.5 | 40.4 | 29.3 | 50.6 |
| Mean temp....... | 17.6 | 19.6 | 26.5 | 37.0 | 47.4 | 56.0 | 61.5 | 60.9 | 53.4 | 41.5 | 29.3 | 21.6 | 39.4 |

## WHEATLAND, PLATTE COUNTY.

Summary of Meteorological Data, 14 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 0.64 | 0.67 | 1.42 | 1.44 | 3.12 | 1.82 | 1.16 | 0.84 | 0.83 | 1.03 | 0.72 | 0.55 | 14.24 |
| Highest temp.... | 68 | 72 | 84 | 88 | 94 | 100 | 105 | 103 | 98 | 89 | 76 | 70 | 105 |
| Lowest temp..... | —22 | —28 | —21 | 7 | 23 | 30 | 41 | 41 | 25 | 18 | —6 | —15 | —28 |
| Mean temp....... | 29.3 | 26.9 | 32.9 | 46.1 | 56.1 | 64.4 | 71.7 | 71.2 | 62.4 | 49.2 | 38.7 | 32.1 | 48.4 |

## WELLS, FREMONT COUNTY.

Summary of Meteorological Data, 4 Years.

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation .... | 2.01 | 1.70 | 2.72 | 1.09 | 2.28 | 1.57 | 1.22 | 2.00 | 0.95 | 0.57 | 0.71 | 0.88 | 17.70 |
| Highest temp.... | 42 | 42 | 47 | 56 | 69 | 78 | 82 | 84 | 79 | 68 | 60 | 43 | 84 |
| Lowest temp..... | —40 | —42 | —29 | —9 | 10 | 21 | 25 | 18 | 15 | 1 | —23 | —30 | —42 |
| Mean temp....... | 12.2 | 14.2 | 21.2 | 30.4 | 30.5 | 47.4 | 54.0 | 52.6 | 45.8 | 35.6 | 24.6 | 15.4 | 32.0 |

# MONTHLY PRECIPITATION CHARTS

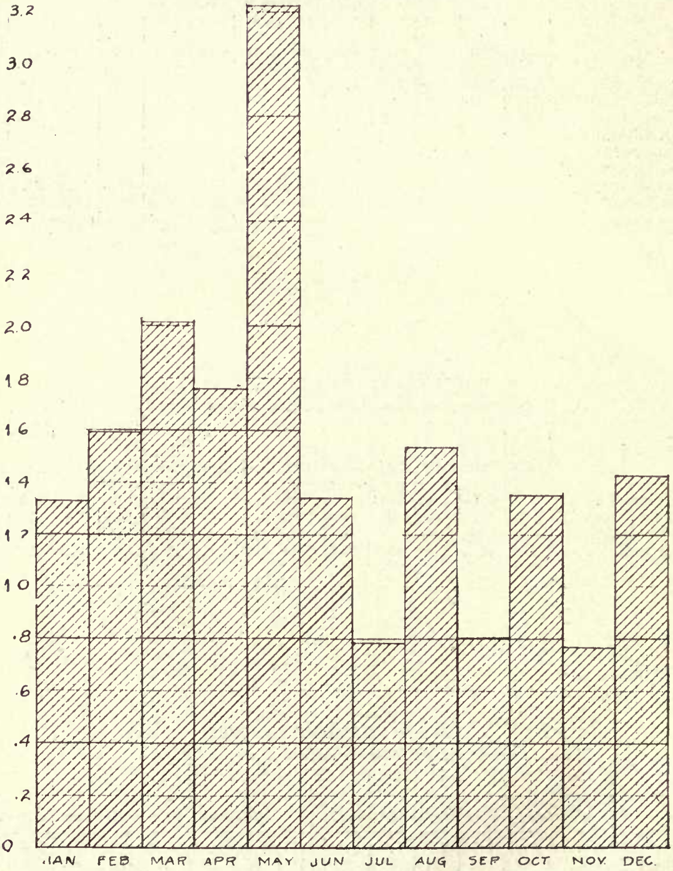


**Fig. 6.—Afton, Lincoln County. Annual precipitation, 18.03 inches. Records for 6 years.**

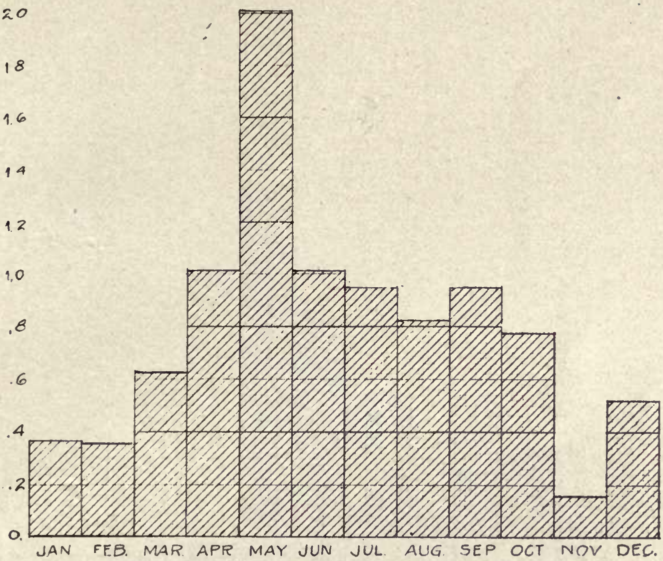


Fig. 7.—Pathfinder, Natrona County. Annual precipitation, 9.65 inches. Records for 11 years.

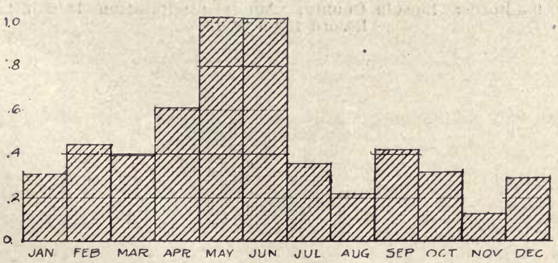


Fig. 8.—Basin, Big Horn County. Annual precipitation, 5.8 inches. Records for 12 years.

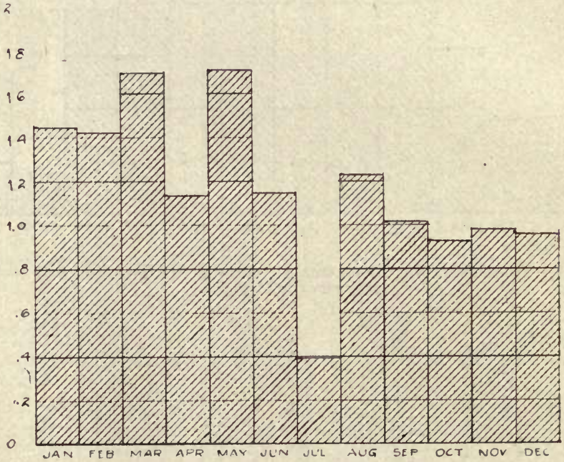


Fig. 9.—Border, Lincoln County. Annual precipitation, 14.05 inches. Record for 9 years.

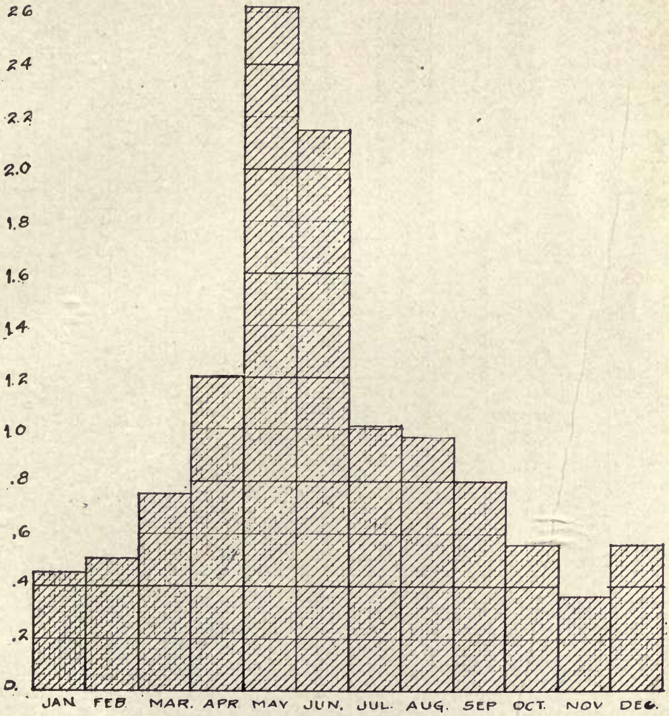


Fig. 10.—Buffalo, Johnson County. Annual precipitation, 11.96 inches. Record for 19 years.

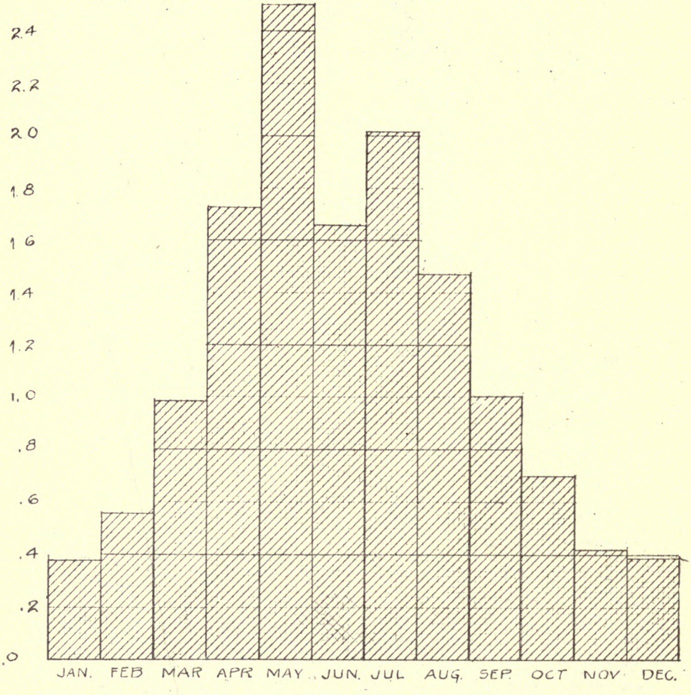


Fig. 11.—Cheyenne, Laramie County. Annual precipitation, 13.80 inches. Record for 40 years.

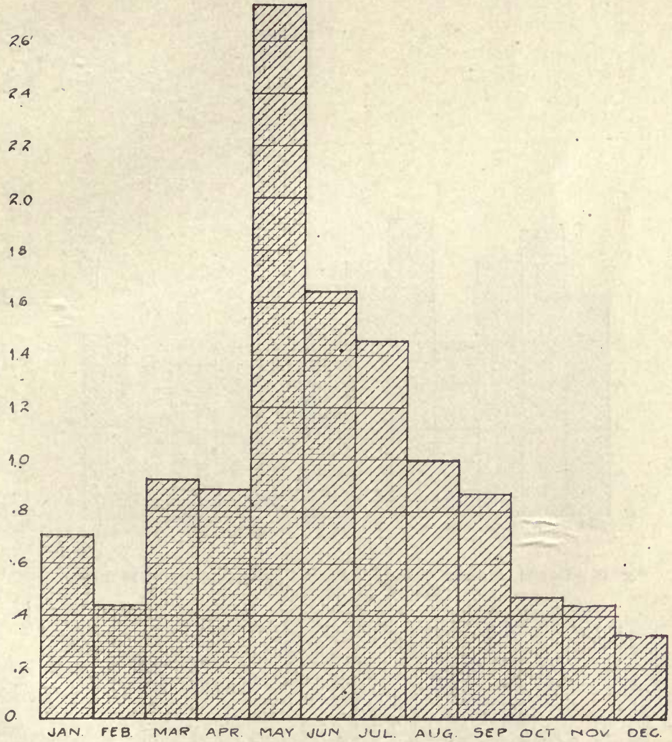


Fig. 12.—Clark, Park County. Annual precipitation, 12.08 inches. Record for 11 years.

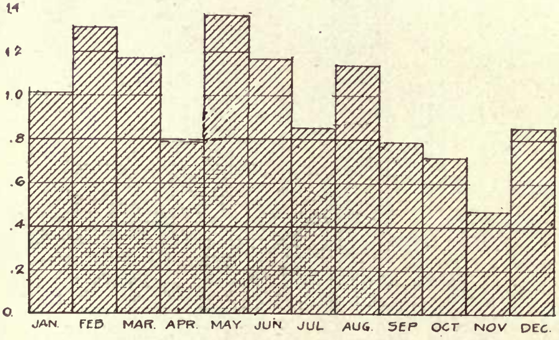


**Fig. 13.—Daniel, Lincoln County. Annual precipitation, 11.70 inches. Record for 11 years.**

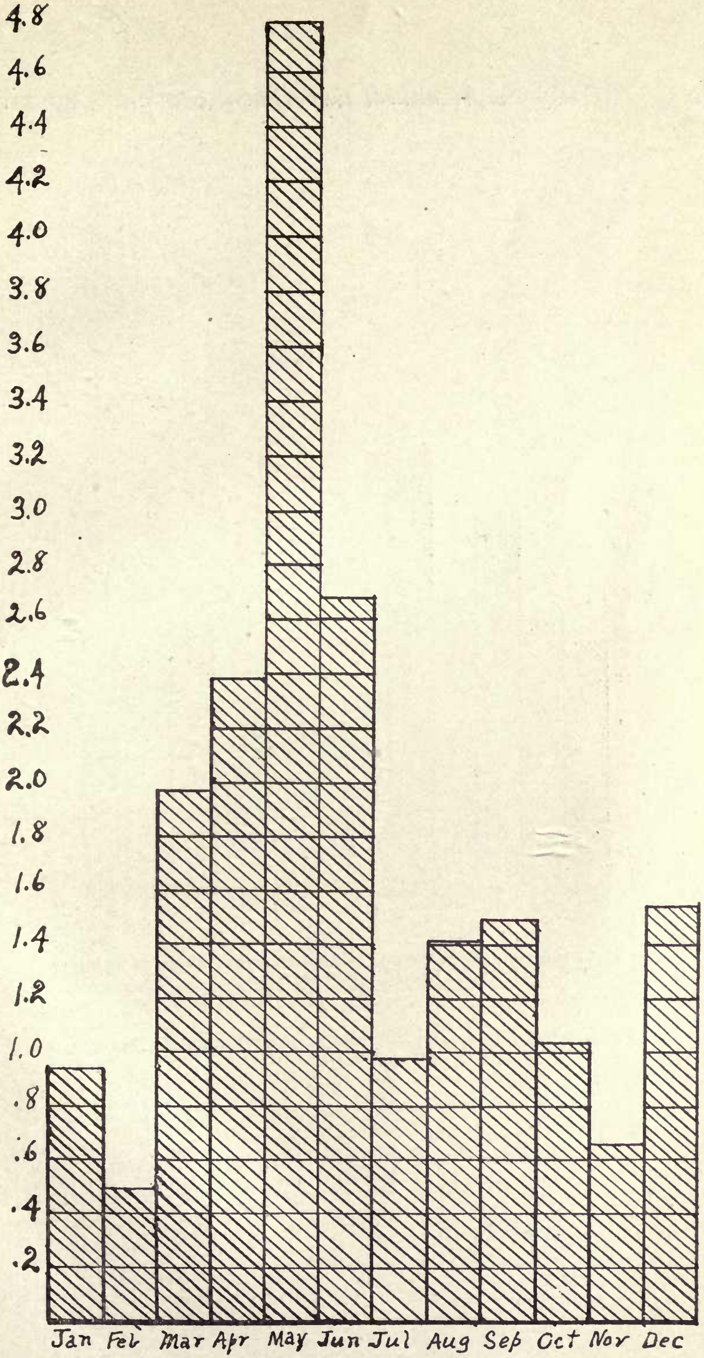


Fig. 14.—Eaton's Ranch, Sheridan County. Annual precipitation, 14.32 inches
Record for 6 years

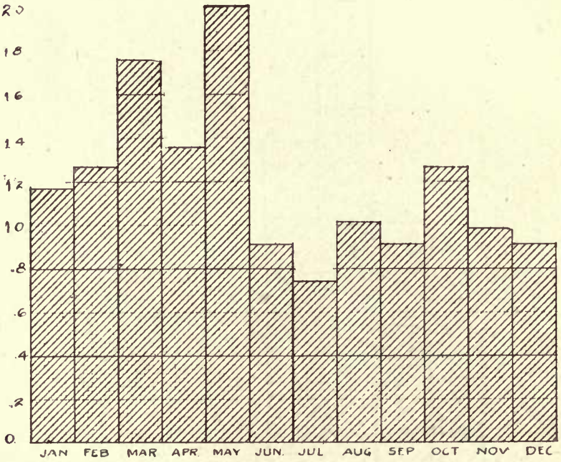


**Fig. 15.—Evanston, Uinta County. Annual precipitation, 14.32 inches. Record for 15 years.**

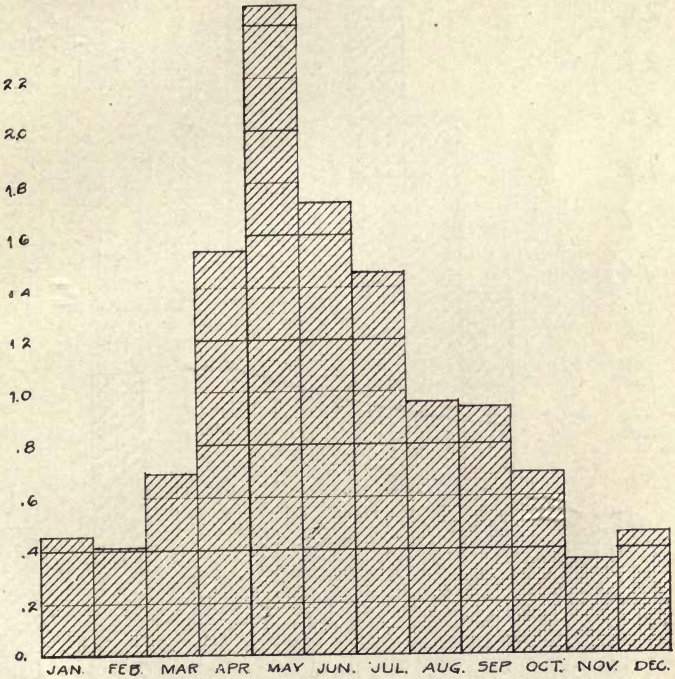


**Fig. 16.—Fort Laramie, Goshen County. Annual precipitation, 14.32 inches. Record for 16 years.**

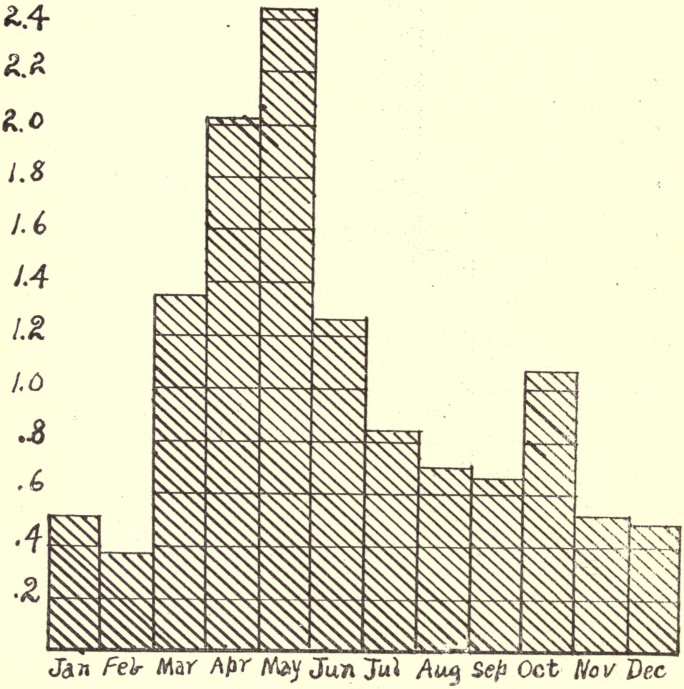


Fig. 17.—Fort Washakie, Fremont County. Annual precipitation, 12.23 inches. Record for 14 years.

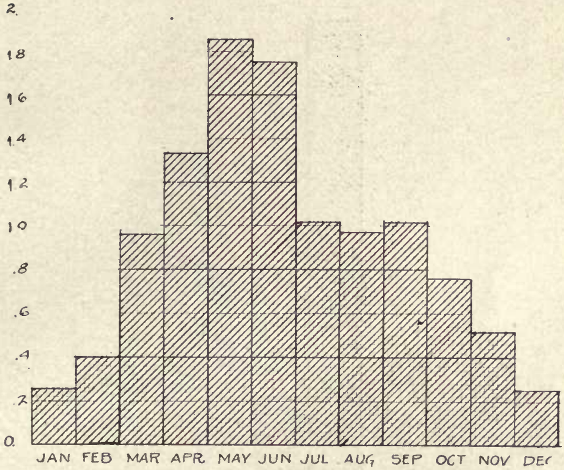


Fig. 18.—Four Bear, Park County. Annual precipitation, 11.21 inches. Record for 10 years.

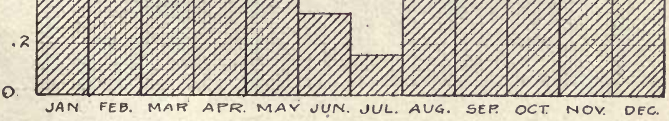


Fig. 19.—Green River, Sweetwater County. Annual precipitation, 7.30 inches. Record for 6 years.

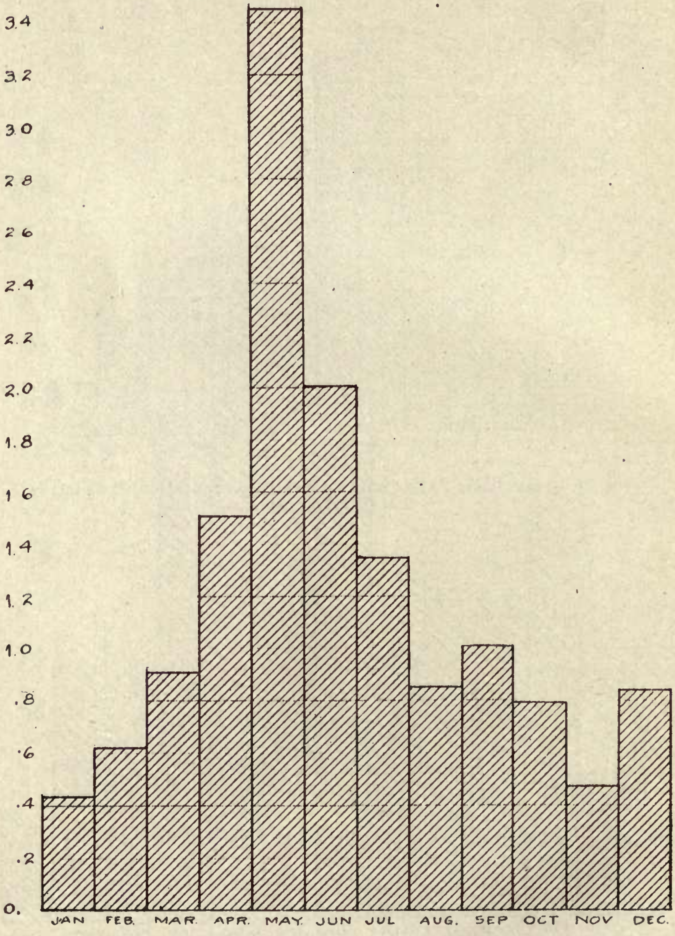


**Fig. 20.—Griggs, Johnson County. Annual precipitation, 14.33 inches. Record for 8 years.**

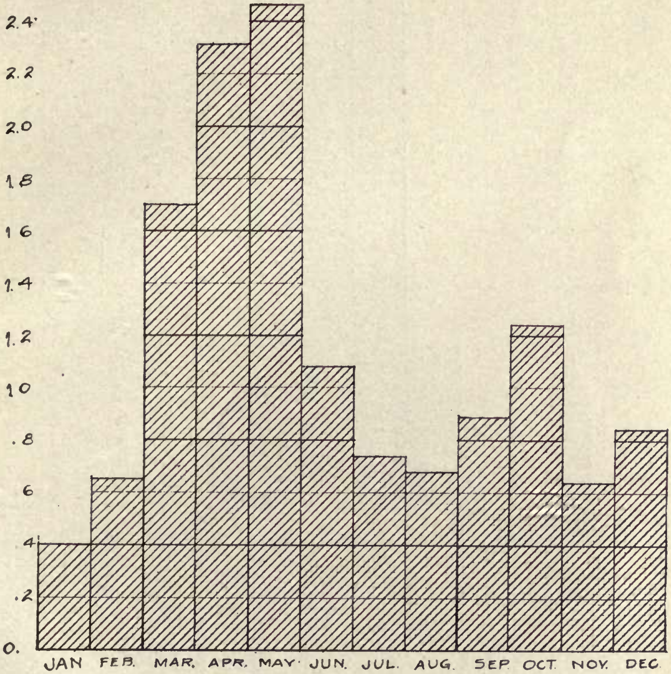


**Fig. 21.—Lander, Fremont County. Annual precipitation, 13.68 inches. Record for 19 years.**

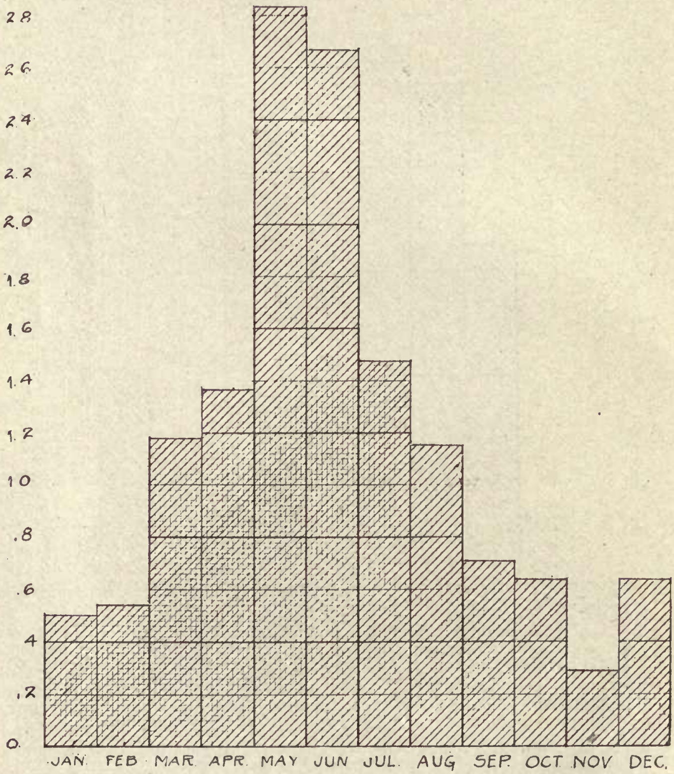


Fig. 22.—Lusk, Niobrara County. Annual precipitation, 14.03 inches. Record for 10 years.

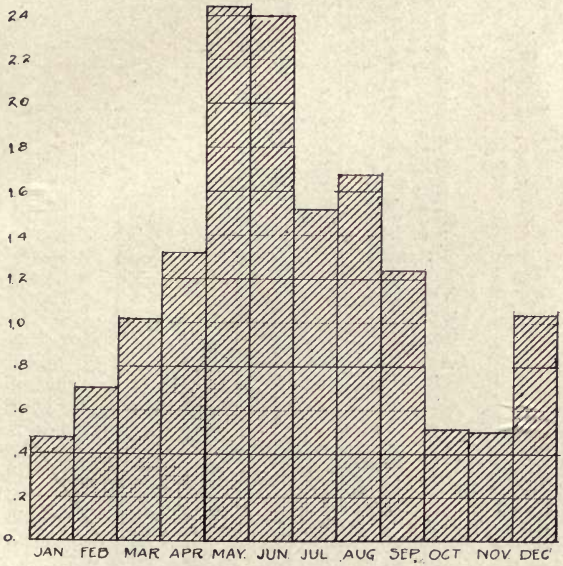


**Fig. 23.—Moorcroft, Crook County. Annual precipitation, 14.80 inches. Record for 7 years.**

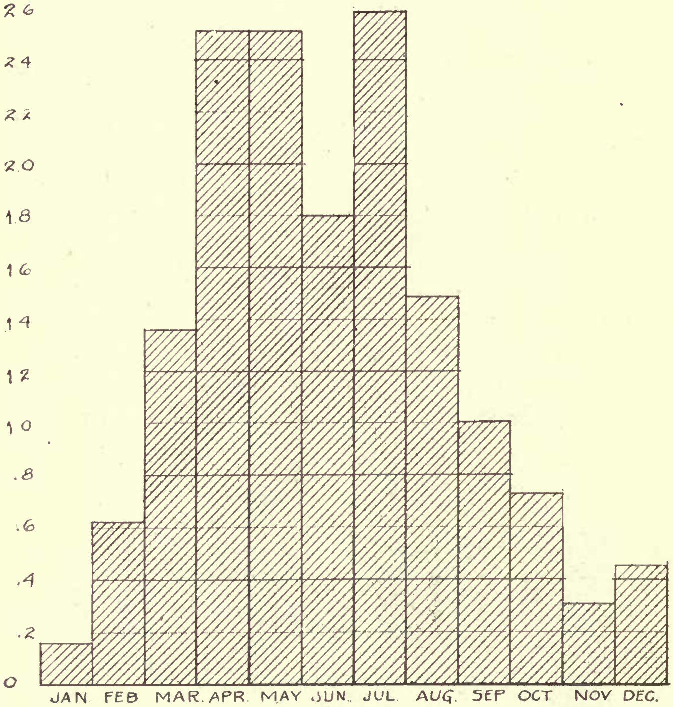


Fig. 24.—Pine Bluffs, Laramie County. Annual precipitation, 15.39 inches. Record for 9 years.

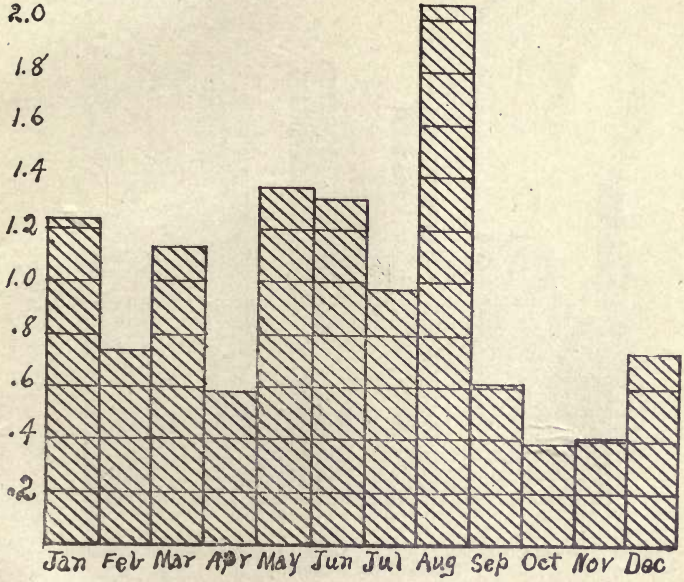


Fig. 25.—Pinedale, Fremont County. Annual precipitation, 11.55 inches. Record for 5 years.

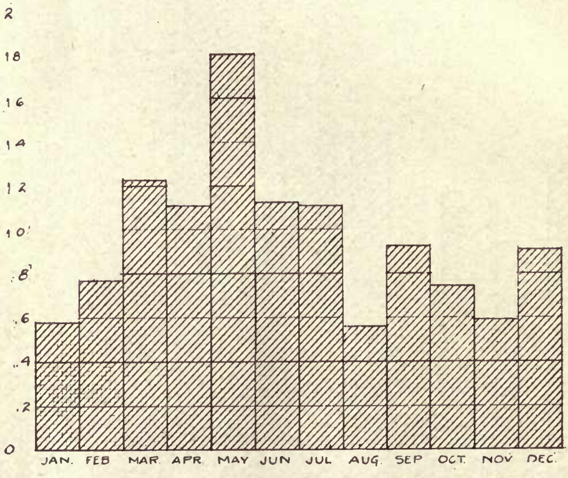


**Fig. 26.—Rawlins, Carbon County. Annual precipitation, 11.47 inches. Record for 5 years.**

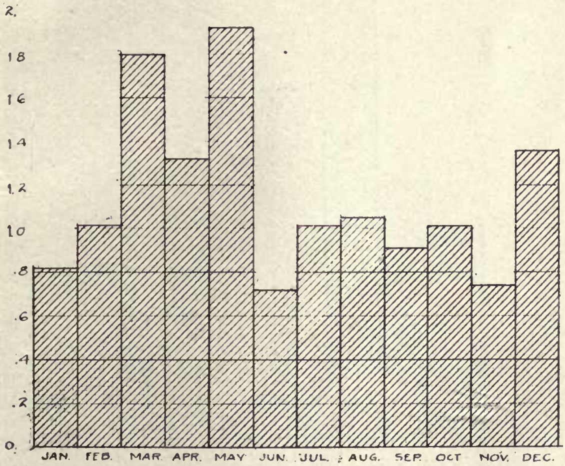


**Fig. 27.**—Saratoga, Carbon County. Annual precipitation, 13.70 inches. Records for 11 years.

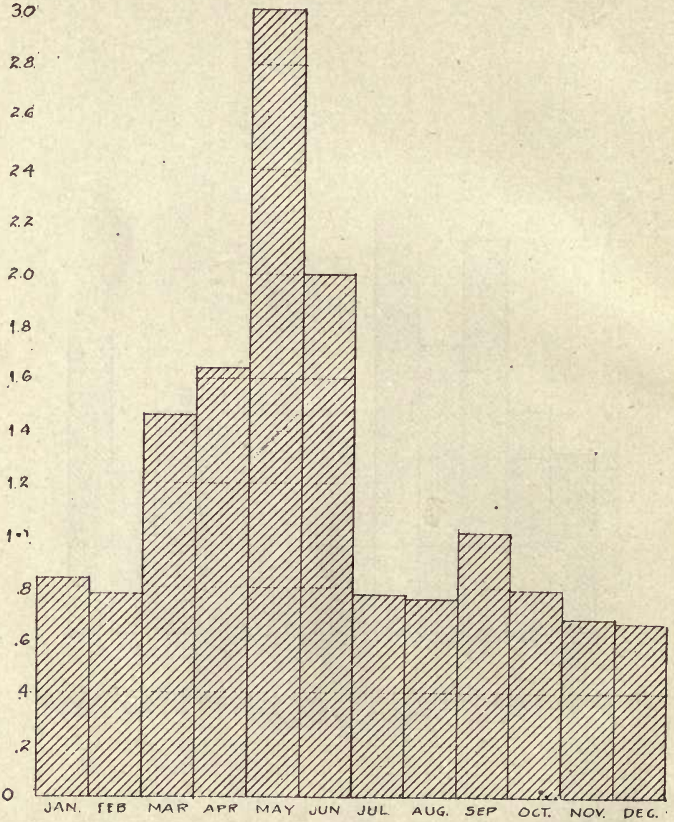


**Fig. 28.**—Sheridan, Sheridan County. Annual precipitation, 14.52 inches. Records for 14 years.

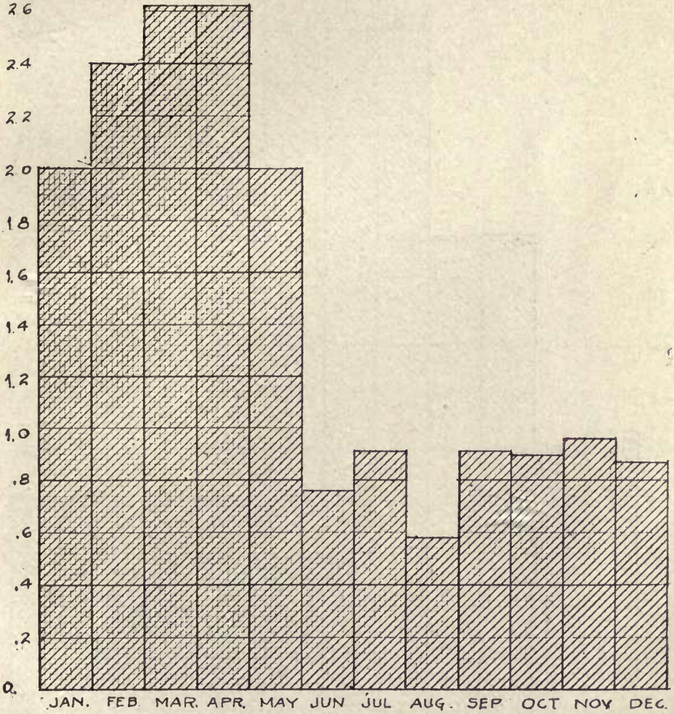


**Fig. 29.—South Pass City, Fremont County. Annual precipitation, 17.60 inches. Record for 9 years.**

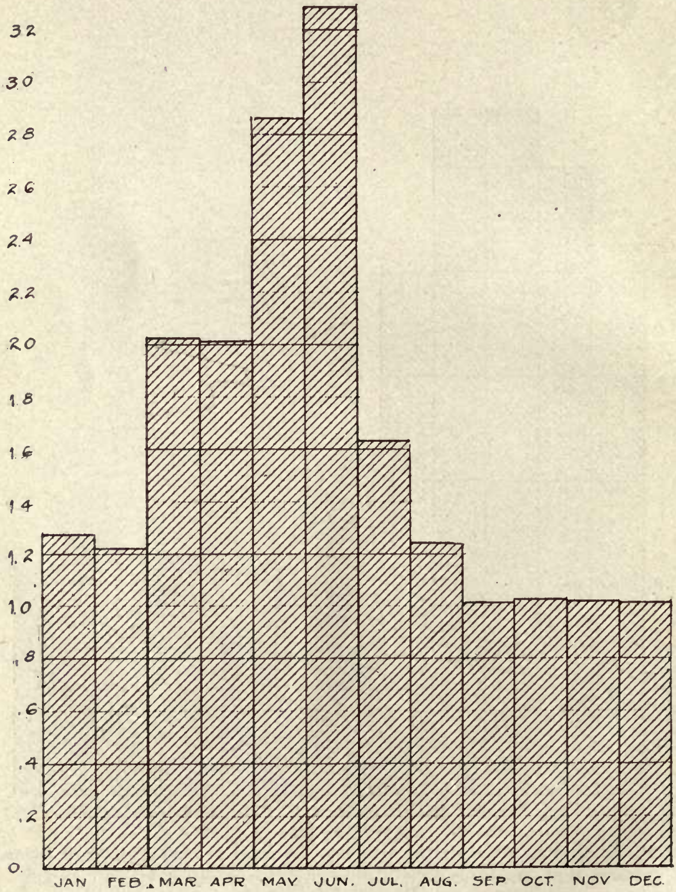


**Fig. 30.**—Sundance, Crook County. Annual precipitation, 20.27 inches. Records for 9 years.

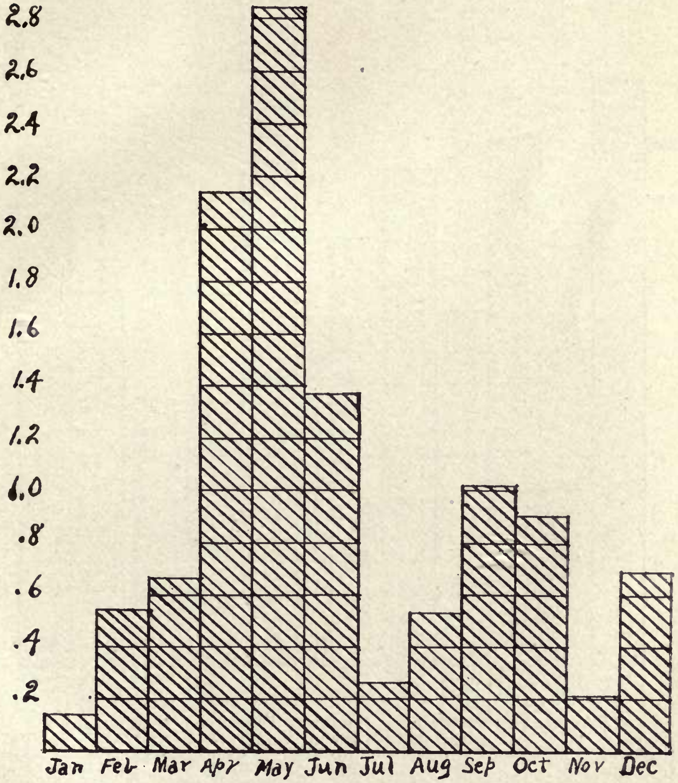


Fig. 31.—Thermopolis, Hot Springs County. Annual precipitation, 11.29 inches. Record for 8 years.

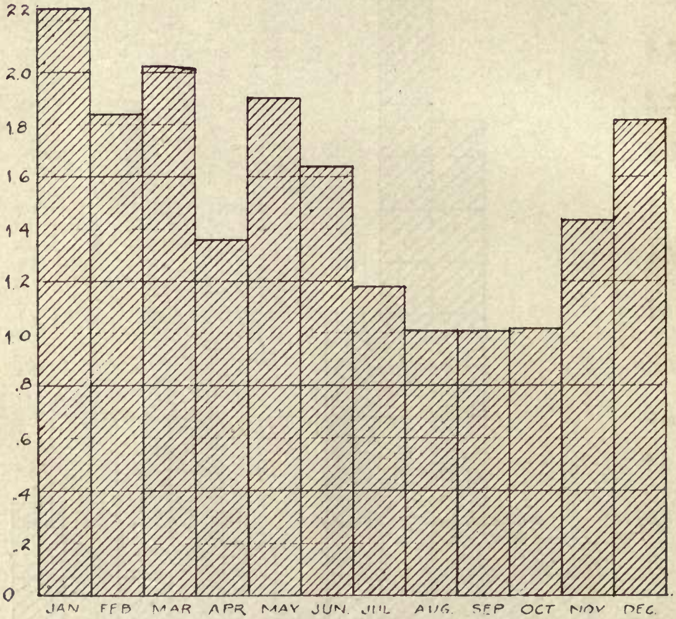


Fig. 32.—Yellowstone Park. Annual precipitation, 18.80 inches. Records for 23 years.

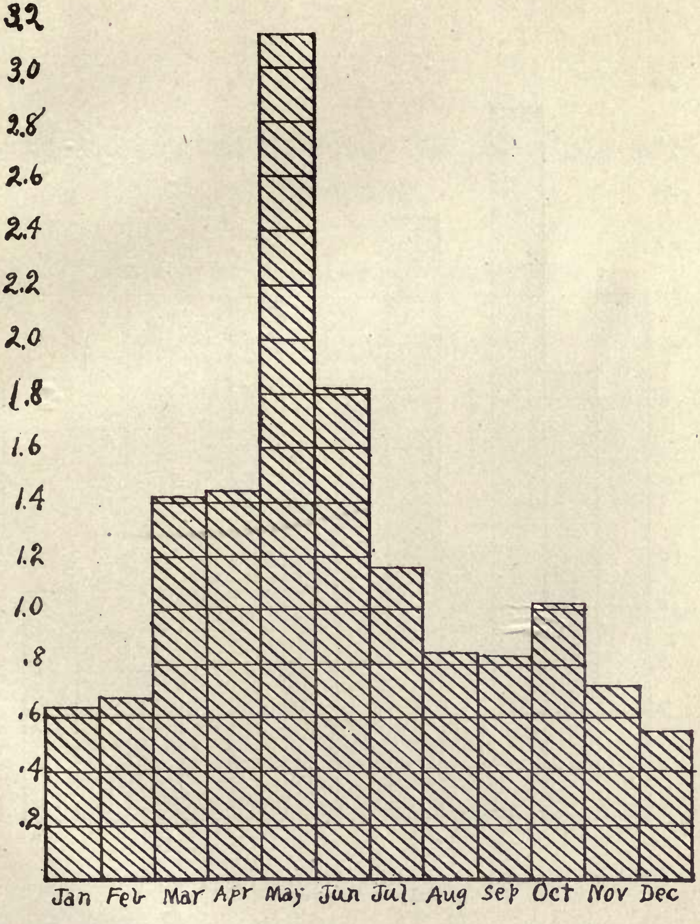


Fig. 33.—Wheatland, Platte County. Annual precipitation, 14.24 inches. Record for 14 years.

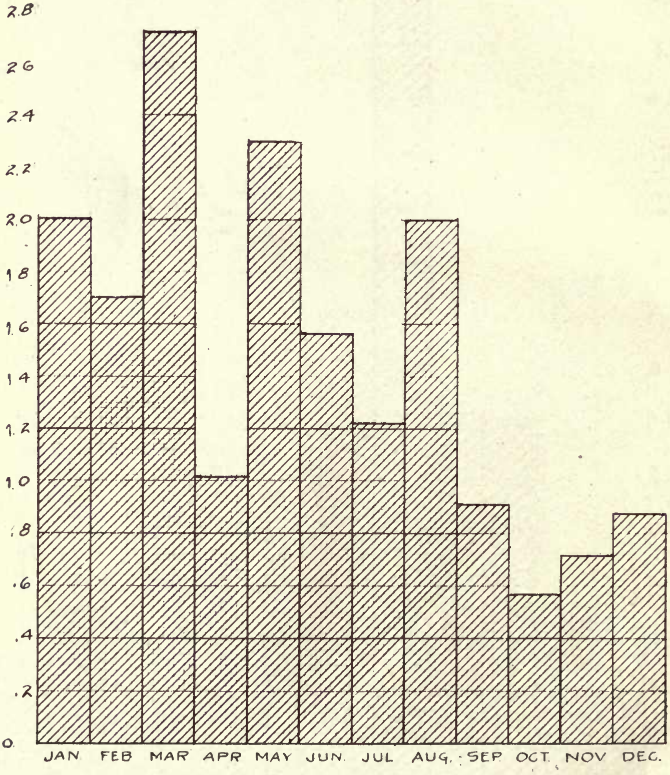


Fig. 34.—Wells, Fremont County. Annual precipitation, 17.70 inches. Records for 4 years.

# Meteorological Summary for the State of Wyoming

STATE OF WYOMING—AVERAGE PRECIPITATION.

| YEAR | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1891 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1.51 | .56 | .60 | .82 | ..... |
| 1892 | .71 | .47 | 1.14 | 2.14 | 2.09 | 1.49 | .69 | .61 | .22 | .90 | .56 | .99 | 12.01 |
| 1893 | .38 | .76 | .69 | 1.45 | 1.62 | .83 | .72 | .95 | .63 | .95 | .79 | .90 | 10.67 |
| 1894 | .51 | .71 | 1.94 | 1.33 | 1.05 | 1.70 | 1.28 | .66 | 1.42 | .41 | .29 | .57 | 11.87 |
| 1895 | .95 | .57 | 1.97 | 2.36 | 2.55 | 3.09 | 1.17 | .91 | .88 | .70 | 1.30 | .45 | 15.90 |
| 1896 | .79 | .63 | 1.94 | 1.63 | 2.10 | 1.67 | 2.04 | .90 | 1.64 | .50 | 1.06 | .10 | 15.00 |
| 1897 | .55 | .82 | 1.72 | .89 | 1.23 | 1.47 | 1.22 | 1.35 | .38 | 1.04 | .68 | .91 | 12.26 |
| 1898 | .55 | .29 | .96 | .93 | 3.78 | 1.68 | .86 | .82 | .25 | .96 | .78 | .64 | 12.50 |
| 1899 | 1.55 | 1.72 | 1.85 | .83 | 1.88 | 1.50 | 1.16 | .82 | .56 | 1.50 | .13 | .69 | 14.19 |
| 1900 | .29 | .92 | .50 | 4.24 | .61 | .84 | 1.09 | .39 | 1.04 | .56 | .38 | .45 | 11.31 |
| 1901 | .24 | .85 | .87 | 1.37 | 2.55 | 1.72 | .75 | .95 | .53 | .75 | .29 | 1.27 | 12.14 |
| 1902 | .25 | .47 | 1.04 | 1.18 | 1.40 | 1.35 | .89 | .22 | 1.21 | .45 | .39 | .96 | 9.81 |
| 1903 | .77 | .67 | .96 | 1.42 | 1.71 | 1.24 | 1.42 | .98 | 1.46 | .67 | .94 | .63 | 12.87 |
| 1904 | .77 | 1.49 | 2.12 | 1.39 | 2.55 | 1.54 | 1.24 | 1.16 | .47 | .78 | .11 | .67 | 14.29 |
| 1905 | .91 | .53 | 1.19 | 2.38 | 3.16 | 1.99 | 1.69 | .96 | 1.16 | 1.05 | .61 | .40 | 16.03 |
| 1906 | 1.24 | .77 | 2.29 | 1.46 | 3.12 | 1.38 | 1.17 | 1.97 | 1.24 | 1.25 | .88 | 1.05 | 17.82 |
| 1907 | 1.25 | .95 | 1.69 | 1.13 | 2.32 | 1.96 | 1.42 | 1.18 | 1.05 | .35 | .36 | .97 | 14.63 |
| 1908 | .47 | .56 | .93 | .94 | 4.62 | 2.75 | 1.31 | 1.87 | .75 | 1.92 | .37 | .84 | 17.28 |
| 1909 | 1.28 | 1.12 | 1.05 | 1.15 | 2.17 | 2.23 | 1.40 | 1.21 | 1.67 | .42 | 1.40 | 1.23 | 16.33 |
| 1910 | 1.11 | .99 | .60 | .94 | 2.06 | .66 | 1.13 | .43 | 1.37 | 1.29 | .87 | .67 | 12.15 |
| 1911 | 1.92 | .82 | .57 | 1.23 | 1.33 | 1.82 | .86 | .74 | 1.01 | 1.47 | 1.40 | .81 | 13.98 |
| 1912 | 0.92 | 1.18 | 1.63 | 1.86 | 1.82 | 1.31 | 2.19 | 2.09 | 2.25 | ..... | ..... | ..... | ..... |
| Sums | 16.49 | 16.11 | 26.02 | 30.39 | 43.90 | 32.86 | 23.51 | 19.08 | 20.54 | 18.48 | 14.19 | 16.02 | ..... |
| Means | 0.82 | 0.81 | 1.30 | 1.52 | 2.20 | 1.64 | 1.18 | 0.95 | 0.97 | 0.88 | 0.68 | 0.7[illegible] | 13.71 |

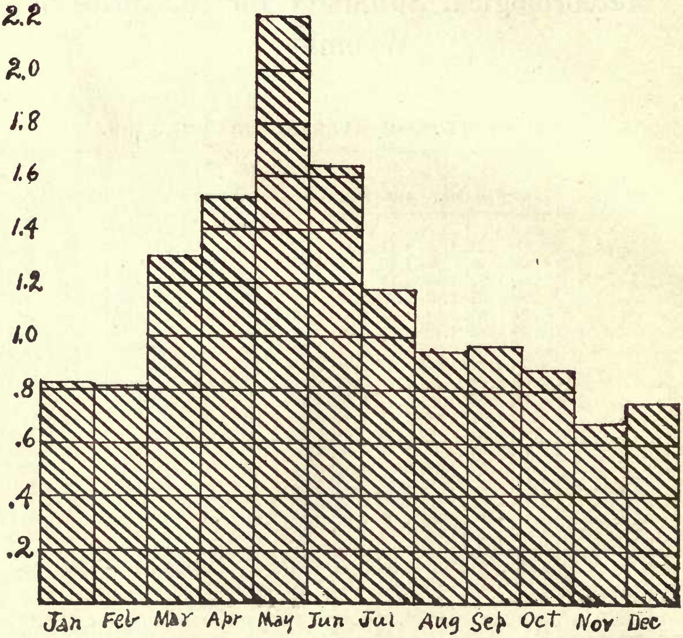


Fig. 35.—Average precipitation by months for the State of Wyoming.

STATE OF WYOMING—MONTHLY MEAN TEMPERATURE.

| YEAR | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1891 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 57.8 | 46.0 | 33.3 | 26.1 | ..... |
| 1892 | 20.3 | 28.3 | 34.1 | 38.3 | 48.0 | 58.2 | 67.5 | 65.1 | 59.5 | 46.8 | 34.7 | 20.6 | ..... |
| 1893 | 25.9 | 21.1 | 28.4 | 36.4 | 48.8 | 60.4 | 68.8 | 65.5 | 57.3 | 44.4 | 30.4 | 27.7 | ..... |
| 1894 | 19.2 | 15.9 | 30.4 | 42.1 | 53.9 | 60.6 | 66.3 | 67.0 | 52.8 | 45.8 | 28.5 | 23.3 | ..... |
| 1895 | 19.2 | 18.7 | 28.5 | 45.2 | 50.3 | 56.6 | 63.7 | 65.7 | 56.7 | 44.9 | 29.6 | 22.5 | ..... |
| 1896 | 27.6 | 28.5 | 27.0 | 40.1 | 50.2 | 62.1 | 67.2 | 65.8 | 54.1 | 44.8 | 23.7 | 32.1 | ..... |
| 1897 | 19.5 | 22.2 | 26.0 | 42.1 | 57.5 | 60.4 | 65.6 | 65.6 | 61.1 | 45.1 | 33.4 | 19.5 | ..... |
| 1898 | 17.7 | 29.0 | 26.2 | 44.3 | 48.0 | 60.0 | 67.4 | 67.9 | 54.2 | 39.7 | 28.2 | 17.4 | ..... |
| 1899 | 22.7 | 11.8 | 25.0 | 41.5 | 48.1 | 57.9 | 65.8 | 63.0 | 57.2 | 40.6 | 36.4 | 21.1 | ..... |
| 1900 | 26.1 | 20.2 | 34.7 | 42.8 | 54.5 | 65.3 | 65.2 | 65.2 | 54.8 | 46.3 | 33.6 | 28.9 | ..... |
| 1901 | 24.1 | 20.5 | 30.3 | 40.5 | 55.6 | 57.2 | 71.1 | 66.6 | 53.2 | 47.2 | 36.9 | 23.5 | ..... |
| 1902 | 20.7 | 29.2 | 30.3 | 40.9 | 52.5 | 59.7 | 62.7 | 64.4 | 53.6 | 46.0 | 32.6 | 23.7 | ..... |
| 1903 | 24.5 | 13.7 | 29.0 | 39.9 | 47.4 | 59.0 | 64.5 | 65.3 | 51.7 | 45.7 | 32.1 | 24.5 | ..... |
| 1904 | 19.6 | 25.7 | 30.1 | 41.1 | 48.6 | 56.4 | 64.7 | 62.9 | 54.8 | 45.6 | 36.6 | 24.4 | ..... |
| 1905 | 21.1 | 16.8 | 35.4 | 39.2 | 45.9 | 56.5 | 61.7 | 63.9 | 55.6 | 37.8 | 32.5 | 19.3 | ..... |
| 1906 | 21.7 | 23.9 | 21.6 | 40.5 | 48.4 | 54.0 | 62.2 | 62.0 | 54.9 | 42.7 | 29.2 | 28.[illegible] | ..... |
| 1907 | 18.3 | 28.2 | 33.8 | 37.8 | 44.6 | 53.7 | 62.6 | 61.1 | 53.2 | 46.5 | 31.8 | 23.4 | ..... |
| 1908 | 21.[illegible] | 24.0 | 30.5 | 43.2 | 46.7 | 54.4 | 64.3 | 60.5 | 55.4 | 40.5 | 31.4 | 22.4 | ..... |
| 1909 | 22.3 | 22.7 | 29.5 | 34.4 | 45.1 | 58.8 | 64.7 | 65.4 | 54.5 | 43.8 | 33.7 | 11.8 | ..... |
| 1910 | 18.1 | 17.2 | 40.4 | 45.8 | 48.9 | 59.6 | 65.6 | 60.4 | 54.5 | 45.3 | 33.8 | 24.0 | ..... |
| 1911 | 22.3 | 18.1 | 33.6 | 37.1 | 48.3 | 59.4 | 61.2 | 59.6 | 53.4 | 39.0 | 25.0 | 17.0 | ..... |
| 1912 | 19.3 | 21.0 | 21.0 | 37.1 | 45.9 | 56.6 | 61.3 | 59.7 | 45.8 | ..... | ..... | ..... | ..... |
| Sums | 4331 | 4352 | 6048 | 8132 | 9913 | 11702 | 13008 | 12829 | 11603 | 9245 | 6757 | 4816 | ..... |
| Means | 21.9 | 21.8 | 30.2 | 40.7 | 49.6 | 58.5 | 65.0 | 64.1 | 55.2 | 44.0 | 32.1 | 22.9 | 42.2 |

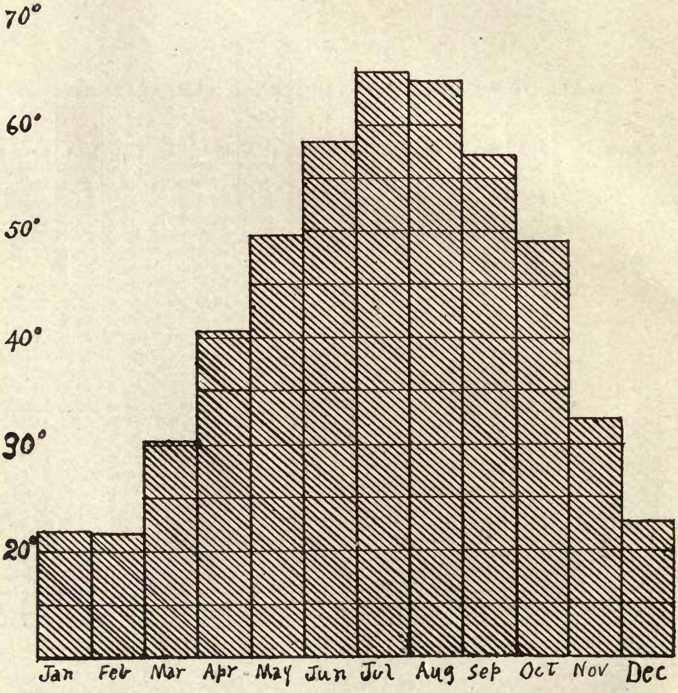


Fig. 36.—Monthly mean temperature for the State of Wyoming.

## STATE OF WYOMING—AVERAGE NUMBER OF RAINY DAYS.

| YEAR | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1898 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 5 | 4 | 4 | ..... |
| 1899 | 7 | 7 | 8 | 4 | 6 | 6 | 7 | 5 | 2 | 7 | 1 | 4 | 64 |
| 1900 | 2 | 6 | 3 | 11 | 4 | 3 | 4 | 3 | 5 | 3 | 3 | 4 | 51 |
| 1901 | 2 | 5 | 6 | 5 | 8 | 7 | 2 | 5 | 3 | 4 | 2 | 7 | 56 |
| 1902 | 3 | 4 | 7 | 3 | 6 | 5 | 5 | 2 | 3 | 3 | 3 | 5 | 49 |
| 1903 | 5 | 5 | 4 | 6 | 9 | 6 | 6 | 5 | 6 | 4 | 4 | 4 | 64 |
| 1904 | 6 | 6 | 10 | 5 | 8 | 6 | 7 | 6 | 3 | 4 | 1 | 4 | 66 |
| 1905 | 6 | 4 | 7 | 8 | 12 | 8 | 8 | 6 | 4 | 6 | 3 | 3 | 75 |
| 1906 | 5 | 5 | 9 | 7 | 10 | 6 | 6 | 9 | 5 | 4 | 6 | 5 | 77 |
| 1907 | 7 | 5 | 8 | 6 | 9 | 10 | 7 | 6 | 5 | 2 | 2 | 6 | 73 |
| 1908 | 3 | 4 | 5 | 5 | 11 | 11 | 7 | 8 | 4 | 6 | 3 | 5 | 73 |
| 1909 | 6 | 5 | 6 | 7 | 7 | 8 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1910 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 59 |
| 1911 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 74 |
| 1912 | ..... | ..... | ..... | ..... | ..... | 7 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Sums | 52 | 56 | 74 | 67 | 90 | 76 | 59 | 55 | 40 | 48 | 32 | 51 | ..... |
| Means | 5 | 5 | 7 | 6 | 8 | 7 | 6 | 6 | 4 | 4 | 3 | 5 | 66 |

## STATE OF WYOMING—PERCENTAGE OF SUNSHINE.

| YEAR | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1898 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 73 | 72 | 76 | ..... |
| 1899 | 67 | 60 | 62 | 77 | ..... | ..... | 64 | 72 | 78 | 51 | ..... | ..... | ..... |
| 1900 | 73 | 50 | 65 | 45 | 68 | 75 | 74 | 73 | 73 | 78 | 63 | 67 | 67 |
| 1901 | 70 | 62 | 61 | 64 | 62 | 70 | 80 | 65 | 76 | 77 | 72 | 50 | 67 |
| 1902 | 74 | 58 | 60 | 66 | 55 | 59 | 64 | 61 | 73 | 63 | 62 | 54 | 62 |
| 1903 | 70 | 64 | 57 | 62 | 60 | 62 | 71 | 74 | 67 | 76 | 62 | 64 | 66 |
| 1904 | 57 | 53 | 56 | 69 | ..... | 62 | 76 | 75 | 81 | 79 | 72 | 55 | 61 |
| 1905 | 43 | 74 | 54 | 58 | 49 | 65 | 72 | 70 | 70 | 61 | 58 | 63 | 61 |
| 1906 | 63 | 67 | 63 | 66 | 61 | 73 | 75 | 71 | 73 | 67 | 51 | 48 | 65 |
| 1907 | 50 | 64 | 62 | 64 | 57 | 64 | 72 | 72 | 64 | 70 | 66 | 58 | 64 |
| 1908 | 68 | 69 | 64 | 76 | 55 | 60 | 76 | 67 | 72 | 54 | 75 | 61 | 66 |
| 1909 | 58 | 66 | 73 | 67 | 66 | 71 | 80 | 78 | 67 | 71 | 47 | 58 | 67 |
| 1910 | 59 | 69 | 77 | 78 | 69 | 76 | 74 | 75 | 65 | 72 | 44 | 59 | 68 |
| 1911 | 51 | 71 | 76 | 63 | 64 | 70 | 70 | 70 | 67 | 63 | 52 | 48 | 64 |
| 1912 | ..... | ..... | ..... | ..... | ..... | 68 | 62 | ..... | ..... | ..... | ..... | ..... | ..... |
| Sums | 803 | 827 | 830 | 855 | 666 | 807 | 952 | 923 | 926 | 955 | 796 | 761 | 787 |
| Means | 62 | 64 | 64 | 66 | 61 | 67 | 73 | 71 | 71 | 68 | 61 | 59 | 66 |

## STATE OF WYOMING—MONTHLY MEAN SNOWFALL.

| YEAR | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1898 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 6.7 | 7.7 | 6.8 | .... |
| 1899 | 15.2 | 18.7 | 18.1 | 5.9 | 4.1 | O | O | T | T | 9.2 | 0.6 | 7.4 | 79.2 |
| 1900 | 2.2 | 9.7 | 4.5 | 22.5 | T | O | T | T | 2.0 | 2.6 | 3.6 | 5.0 | 52.1 |
| 1901 | 3.1 | 9.0 | 9.1 | 12.7 | 0.1 | 0.2 | O | O | 0.8 | 0.8 | 2.6 | 12.9 | 51.3 |
| 1902 | 3.0 | 5.1 | 8.7 | 4.4 | 1.1 | T | T | O | 0.4 | 0.1 | 3.0 | 11.3 | 37.1 |
| 1903 | 7.2 | 7.5 | 9.0 | 8.1 | 3.5 | O | T | O | 7.3 | 0.8 | 8.3 | 6.9 | 58.6 |
| 1904 | 9.4 | 14.2 | 16.4 | 5.2 | 1.8 | 0.2 | O | T | T | 3.2 | 0.9 | 5.9 | 57.2 |
| 1905 | 10.3 | 5.8 | 9.9 | 14.5 | 9.4 | 0.5 | O | O | 1.9 | 7.1 | 6.5 | 4.6 | 70.5 |
| 1906 | 11.7 | 9.2 | 22.6 | 9.1 | 2.6 | 1.2 | O | O | 0.9 | 11.0 | 6.8 | 10.3 | 85.4 |
| 1907 | 17.7 | 10.0 | 12.0 | 10.8 | 9.3 | 0.3 | O | T | 0.6 | 0.3 | 3.6 | 11.5 | 76.1 |
| 1908 | 5.4 | 6.3 | 10.4 | 4.3 | 14.8 | 0.6 | T | T | 2.2 | 10.8 | 4.4 | 10.6 | 69.8 |
| 1909 | 14.7 | 14.2 | 11.7 | 12.5 | 2.7 | T | T | T | 0.6 | 2.0 | 11.5 | 15.8 | 85.7 |
| 1910 | 11.3 | 9.1 | 3.6 | 4.3 | 6.1 | T | T | T | 0.4 | 2.4 | 6.5 | 6.6 | 50.3 |
| 1911 | 20.9 | 9.6 | 6.3 | 9.7 | 3.3 | T | T | T | 0.3 | 5.8 | 19.9 | 10.1 | 85.9 |
| Means | 10.2 | 9.9 | 10.9 | 9.5 | 4.5 | 0.2 | T | T | 1.2 | 4.5 | 6.1 | 9.0 | 66.1 |

## STATE OF WYOMING—PREVAILING DIRECTION OF WIND.

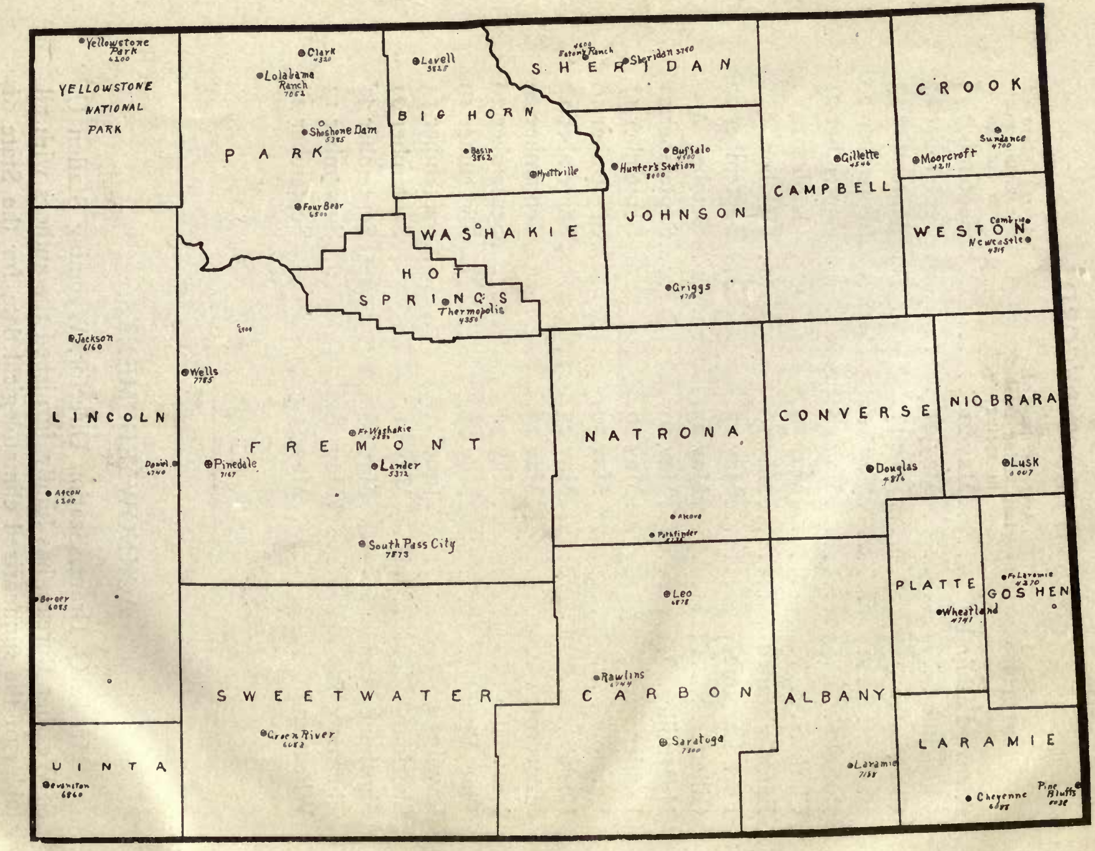
| YEAR | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1898 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | W | W | NW | ..... |
| 1899 | W | NW | W | NW | SW | W | W | sw w | NW | W | SW | W | W |
| 1900 | NW | W | W | ..... | W | W | W | SW | SW | W | W | W | W |
| 1901 | W | W | W | W | W | W | W | W | W | W | W | NW | W |
| 1902 | SW | W | W | W | W | W | W | W | W | W | W | W | W |
| 1903 | W | W | W | W | W | W | W | W | W | W | W | W | W |
| 1904 | W | W | W | W | W | W | W | W | W | W | W | W | W |
| 1905 | W | W | W | W | W | W | W | W | W | W | W | W | W |
| 1906 | W | W | W | W | W | W | W | W | W | W | W | W | W |
| 1907 | W | W | W | NW | NW | W | W | W | W | W | W | W | W |
| 1908 | W | W | NW | N | W | W | W | W | W | NW | W | W | W |
| 1909 | W | W | W | W | W | W | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1910 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1911 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1912 | ..... | ..... | ..... | ..... | ..... | W | W | ..... | ..... | ..... | ..... | ..... | ..... |
| Means | W | W | W | W | W | W | W | W | W | W | W | W | W |

## STATE FROST RECORD.

| STATIONS | Average date of last killing frost in spring | Average date of first killing frost in autumn |
|---|---|---|
| Alcova-Pathfinder | May 21 | September 19 |
| Cheyenne | May 21 | September 17 |
| Chugwater | June 1 | September 15 |
| Basin | May 10 | September 20 |
| Buffalo | May 28 | September 21 |
| Clark | May 4 | October 14 |
| Eaton's Ranch | May 16 | October 5 |
| Fort Laramie | May 15 | September 20 |
| Gillette | May 23 | October 4 |
| Hyattville | May 19 | September 21 |
| Lander | May 26 | September 11 |
| Laramie | May 30 | September 16 |
| Lusk | May 25 | September 13 |
| Moorcroft | May 23 | September 20 |
| Newcastle | May 22 | September 20 |
| Pine Bluffs | May 27 | September 19 |
| Rawlins | June 3 | September 13 |
| Sheridan | May 21 | September 24 |
| Shoshone Dam | May 26 | September 21 |
| Thermopolis | May 8 | September 13 |
| Wheatland | May 11 | September 24 |

## ACKNOWLEDGMENTS.

Mr. R. Q. Grant, Section Director, Wyoming Station U. S. Weather Bureau, has kindly furnished the authors with all tables of the summarized climatological data for the State of Wyoming, compiled from the records in his office.



WYOMING, SHOWING POINTS AT WHICH WEATHER OBSERVATIONS WERE MADE. Small figures give altitude.

| | | |
|---|---|---|
| LOAN PERIOD 1 | 2 | 3 |
| 4 | 5 | 6 |

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